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THE DETROIT MUNICIPAL PLANT.

As our readers will remember, as far back as last February we published an analysis of the Seventh Annual Report of the Public Lighting Commission, when we attempted to determine more closely what actual advantages, if any, were shown by the report from the operation of the station, and when it was clearly proved that the plant was by no means such a success as had been made out. After some months had gone by, Commissioner Ingram, under date of May 18, forwarded us an article which in turn we have subjected to further investigation, and which we now print in the present issue, accompanied by our own comment as supplemented by the data that we have been able to obtain locally. We must now leave these figures to our readers and the public in general. It seems to us that our first analysis as a piece of destructive and unanswerable criticism stands, and that Commissioner Ingram's reply does not in any wise get to the heart of the various questions which we raised. Perhaps the most serious issue raised is that with regard to depreciation, a respect in which it has always appeared to us the reports of the Commission were weak.

There are other questions of fact raised, but we will touch here upon only one of them, namely, whether or not a costly pole line has been "abandoned." Mr. Ingram, in his reply, questions the statement about the line which was made in our analysis. We now quote his own statements and give in the body of the matter three photographs of the pole line in question. One other little point comes up and that is Mr. Ingram's reference to the indictment of certain aldermen at Saginaw, Mich., for alleged bribery. We confess we do not follow his line of argument here at all, for if such men were vile and corrupt enough to hold up a public service corporation endeavoring to carry on its legitimate business, it is simply fearful to imagine what they would do if they had free and unlimited control of the city resources for every class of public service under a régime of public ownership of every large utility.

THE INSTITUTE MEETING.

Last week we gave in full the programme for the Institute meeting at Niagara Falls as it had been outlined by the various committees, and we are now able to supplement that by the latest information available on the subject. It will be seen that a programme of unusual attractiveness and importance has been prepared, and we do not think we are mistaken in predicting a large attendance, especially if the unpropitious weather from which the country has suffered during the past month should terminate and the sun should shine again. While Niagara itself has already been done pretty thoroughly by the Institute at other times, it is fortunate that this year, altogether apart from the excellent papers that are to be presented, the excursions and trips include a number of outlying points of interest where something of value may be seen and learned. At the same time, in view of the fact that questions of power transmission and distribution occupy so largely the attention of this body, it is not to be regretted that at Niagara so much practical information can be ascertained right on the spot as to devices connected with this class of work. These features are, in fact, given special prominence by the preliminary notes of discussion issued by the Mershon Committee on high-tension transmission, and we trust that a very full and profitable discussion will be had on this subject.

Magnetic Polar Expeditions.

It is announced that the Norwegian whaling vessel *Gjoa* has recently sailed from Christiania on a voyage of discovery for the north magnetic pole. Of course, the position of the north magnetic pole is already fairly well known. It is found marked in the maps at about 70° of north latitude, and 100° of west longitude, which, being interpreted, means in the McClintock channel, between Boothia, William Land, Prince of Wales Island, and Victoria Land. Evidently the North Pale is a strong supporter of the British crown. It also lies due north of Dodge City, Kan., and at a desirable distance therefrom. It is clear, therefore, that the search for the north magnetic pole is more hopeful than the quest of the holy grail. The principal problem before the casual voyager is what to do when he gets there, and how soon to remember a distant engagement.

Nevertheless, much valuable magnetic data can be accumulated in that remote and undesirable residence for a vacation. The accurate observation and recording of magnetic inclinations and intensities in this vicinity should enable many important deductions to be arrived at concerning the shifting and variation of the pole, and illuminate our theories of terrestrial magnetism.

It seems remarkable that the principal interest in the magnetic pole is in its excursions and round trips. The polar point moves to and fro, like a polar bear. If it were of constant locality and intensity, its interest would be limited to a dot on the map. Similarly, the interest in the north geographical pole lies more in its small wanderings than in its precise locality at any time, notwithstanding the fact that it would be an interesting place to reach and say good-bye to. It is said to spend its time in perambulating a complicated but definite curve comprised within a circle of a couple of hundred feet in diameter. If even a thing so fixed as the pole in this our world cannot stay still, how much excuse and consolation may we find for the restlessness of its ephemeral inhabitants.

The Graduating Classes.

This is the season of the year when all the colleges and universities are sending out into the world the young men who for three or four years have been studying more or less earnestly for the careers to which they propose to give up their lives. The numbers of the graduating classes and their size, as well as the massed groups portrayed on college steps and campuses, are quite portentous, and may well cause wonder as to how all are going to find elbow room. But this is a large country, and it still absorbs very easily not only its own yearly product of educated men, but finds places for a good many from abroad. The medical and legal batches still seem unduly big, and it is perhaps in law and medicine that the beginner feels the crush from above as well as from below, in trying to plant himself firmly. It would appear, however, that theology is hardly so attractive as it once was, and perhaps the youth who would have become priests and clergymen are now more likely to turn up as lawyers and doctors—possibly now and then as journalists. Certainly very few of them try to break into the engineering ranks. Perhaps the Civil Service, growing rapidly as it does, provides careers for a good many of the literati.

Large as the various engineering classes have become, it may be questioned whether any of them have yet proved unwieldly; and the bulletin boards in lots of halls still reveal the urgent demand for likely newcomers. We have been greatly gratified in noting reports from the different institutions to observe how readily the electrical engineering graduates have been absorbed into the ranks of the workers. Curiosity is sometimes expressed as to what all these embryonic Edisons will find to do, but it is the fact that for every one of them worth his salt, occupation has been waiting. Indeed, some of the manufacturing and operating companies are quite strenuous in the eagerness they show to catch the promising graduate even before he is hatched out; and it would be hardly an exaggeration to say that very often instead of the student waiting humbly hat in hand for a job, he has had flatteringly pressing invitations extended to him to step right up and take a comfortable position. All this is very encouraging, and our only prayer is that it may long continue. The remarkable growth of electrical activities would indicate that the demand for well-trained men will expand.

It would be unfortunate, however, if the demand were to cause an insensible lowering of the scale of graduating excellence and proficiency; or tempt students to leave college with courses uncompleted, for they know at best little enough when they face the actualities. We venture to think, however, that the tendency is the other way; that the standard is rising, and that so far as the electrical engineer is concerned, it can hardly be too exacting. In this issue, bearing upon the point, is a very suggestive article by Prof. Sever dealing with the studies of the electrical engineer at Columbia University, and accompanied by a diagram illustrative of the interrelation of the yearly work. We are glad to point to the attention given to the "humanities" in the curriculum and to the emphasis laid on mathematics. Quite aside from his technique, the electrical engineer should be altogether the equal of practitioners in other professions by his acquaintance with general culture and his acquirement of the qualities and amenities that distinguish the gentleman.

Saving the Rainfall.

The terrific floods of the last few weeks ought to teach a lesson that will not soon be forgotten. The wholesale wanton destruction of forests is doing its work, and each decade seems to show greater fluctuations in the water supply. A distinguished Australian engineer, in speaking recently of the flood danger in this country, strongly advised an attack on the Mississippi problem not with levees near the mouth, but with reservoirs at the headwaters. If the flood water is merely kept in the channel, it may be prevented from doing any positive harm, but it is lost and with it an immense amount of possible benefit. The great Assouan dam controlling the flow of the Nile is an example of what intelligent engineering can do toward modifying the natural order of things. To be sure, the valley of the Mississippi proper stands in small need of irrigation, but many of its tributaries on the western side flow through an arid country, which could be saved by a wise use of the water now available by judicious impounding. A series of artificial lakes thus formed would serve a triple purpose. First, they would tend to modify the climate in the direction of greater uniformity; second, they would furnish a vast store of water for irrigation; and finally, the use of the waste head for generating electric power would furnish a source of revenue which would go far toward putting the work on a sound financial basis. Storage reservoirs demand heavy initial expense, and while the damage done in a single flood would, if prevented, amply justify the investment, a steady sale of power from the waste water would give an income of no insignificant amount. The use of this power for pumping water for further irrigation in districts not readily reached by the gravity supply would furnish an important market.

A New Crop of Radiations.

We have already called attention to the recent work of M. Blondlot in finding light of high refrangibility and conspicuous penetrative

powers emitted from x-ray tubes. More recently the somewhat anomalous properties of these new rays led him to an investigation of the radiation of a Welsbach mantle, using a tiny spark as indicator as in the previous research. Rubens found by the bolometric method certain presumably infra-red waves of very great wave length in radiation from this source; and following up this line with his sensitive spark, Blondlot found not Rubens' rays, but four other groups of rays having indices of refraction between 2.0 and 3.0 in quartz and possessing remarkable penetrative power as well as very sharp and decisive action on the spark used to detect them. They passed with ease through thin material—wood, rubber and the like, but with difficulty through rock salt, water, or even wet paper. They seemed in this particular to resemble ordinary infra-red rays of very great wave length, yet were very highly refrangible. Quartz, however, exhibits very strong selective absorption in portions of the infra-red, as well as notable absorption of the extreme ultra-violet, so that the exhibition of anomalous dispersion required to account for the enormous refractive indices observed might reasonably occur. Still more recently, Blondlot has extended his investigation further and finds allies of the new rays to be emitted from an Argand flame, and even from incandescent silver, the rays in the latter case being strongly polarized. The effect of the new rays on phosphorescence was tried, and while they failed to visibly initiate it in calcium sulphide, they seemed to intensify it when once present.

It should be reiterated that these new and remarkable rays are unmistakably light, although their exact wave lengths have not yet been determined. They are reflected, refracted and polarized by the usual means, are brought nicely to a focus by a quartz lens, and are totally reflected at the incidence required by their refractive indices. Yet they penetrate most opaque substances almost as freely as the x-rays and produce a most powerful effect on electrical discharges. They work up to a longer distance from the source than the penetrative radiations usually studied, and are not under the least suspicion of being ions, electrons, emanations, effluvia, auræ, or any other queer and unusual things. The discovery of this group of rays seems to us of a very high order of importance. Their study will be a revelation in the general theory of radiation, and their unusual properties will serve to broaden the current conceptions of transparency and opacity, as well as the view of the interrelations between radiant energy and electrical actions. These are days when an immense amount of information is being steadily collected, all bearing on the fundamental questions of the structure of matter and its relation to radiant and other forms of energy. But the aggregate is far from homogeneous; it has been collected by various methods, under various working hypotheses, and it is a confused heap of facts, apparently very difficult to marshal in any semblance of order. The peculiar value of M. Blondlot's discovery lies in its dealing with things which bear a direct and comprehensible, even if unclassified relation to the general theory of radiant energy. It gives a safe ground on which to stand in further investigations; and in particular it gives hope of throwing new light on the subject of highly penetrative rays and of reducing them to simpler terms than at present.

WIRELESS AND OTHER TELEGRAPH CONFERENCES

A preliminary wireless telegraph conference is announced to be held at Berlin on August 4th, 1903. It is to be attended by persons interested in wireless telegraphy. How far this is open to the public attendance, and how far its sessions are to be restricted to nationally-appointed delegates, has not yet transpired.

There are various directions in which a consensus of opinion on the international relations of wireless telegraphy might advantageously be secured. Such, for instance, are questions concerning the uniformity of Morse code signals, the best range of lighthouse signals as between advantageous distance and disadvantageous interference, and the desirability of equipping lighthouses, all over the world, with wireless telegraph apparatus.

On the other hand, there are many important questions which cannot, perhaps, be profitably discussed at the present time, partly because the existing systems of wireless telegraphy have been too recently developed to conform as yet with commercial requirements, and partly because of the complex patent and legal situations between the owners of the systems and the public. It would appear that at some time it will become necessary for governments to regulate and recognize wireless systems and communications, if only to protect the shipping interests; but the present time seems too early to risk interference with the growth of a new utility and its industry.

An international telegraph conference has recently been held in Europe. These conferences have been assembled periodically for many years, for the purpose of facilitating agreement and co-operation between the telegraph administrations of the various governments. Here tariffs are discussed, adjusted and decided upon, codes regulated and tabulated; while many minor details of international wire-telegraphy are reduced to system. Such action is clearly called for among countries that carry on a large and ramifying joint telegraphic business, in which one and the same message may have to be forwarded through several countries and their telegraph systems.

It is highly desirable that there should be one and only one code of telegraph signals all the world over, both for wire and wireless messages. At the present time there is the Morse code of North America, the International code of Europe, Asia, Africa and Australasia, and there are minor differentiations from these, as in Mexico, whose Morse code has a few signs that are neither Morse nor continental. There is very little actual conflict between the Morse and continental. They differ in the numeral signs, and in about ten letters of the alphabet. The Morse code uses "spaced" letters; while the continental code does not. That is to say, any signal of the continental code is constructed of dots, dashes and spaces of dot length. In the American Morse code, any signal is composed of dots, dashes, single-dot-length spaces, and extra-length spaces. The American code is about five per cent. faster than the continental code, for the same speed of transmission reckoned in dot-intervals, there being more dashes per word in the continental code, and, therefore, more time consumed per word. On the other hand, the continental code is the less liable to errors in transmission accompanying any derangement of the signals due to imperfect working of the system. Thus the American system is swifter; while the continental system is safer.

The continental system is used practically all over the world outside of America. The continental code is used over all long cables, and on messages coming to the United States, the change in signals occurs where the cables breathe the messages upon the American shore. In Great Britain the signal code was at one time different from the continental, but in order to adhere to the international continental code, the original British code was abandoned and is now extinct. It is doubtful whether it would be worth taking the trouble to change codes in this country merely for the sake of international uniformity, when the existing system here is found satisfactory, and when the only clash is at the termini of the cables. But if wireless telegraphy comes into general use all over the world the desirability of employing the same code everywhere will be enhanced.

The Union Engineering Building.

A formal organization of the joint committee representing the various bodies which have taken action with respect to the gift of $1,000,000 of Mr. Andrew Carnegie for a Union Building, was effected on the evening of June 18. The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Engineers' Club have taken final action and appointed their representatives upon a joint committee for accepting the gift. The American Institute of Mining Engineers has likewise taken action insofar as its rules permit. Its council has appointed representatives subject to changes in the rules of the organization which have been proposed by the council for adoption at the next general meeting. At the present time a letter ballot for ascertaining the attitude of the members is being taken which shows an overwhelming majority in favor of the plans proposed by the council.

The American Society of Civil Engineers at its recent meeting in Asheville referred the matter to its board of directors for recommendation and directed that the matter be then presented to the members of the society for letter ballot.

At the meeting on June 18, the following were announced as representatives of the several bodies upon the joint committee:

American Institute of Mechanical Engineers, James M. Dodge, F. R. Hutton, Charles Wallace Hunt.

American Institute of Electrical Engineers, Charles F. Scott, B. J. Arnold, S. S. Wheeler.

American Institute of Mining Engineers, A. R. Ledoux, Charles Kirchoff, Timothy Dwight.

Engineers' Club, John C. Kafer, W. H. Fletcher, W. A. Redding.

Representatives of the American Society of Civil Engineers are requested to meet with the joint committee and take part in deliberations with regard to the plan to be adopted. The representatives who have served upon the conference committee are Alfred Noble, W. J. Wilgus, George M. Pegram.

The joint committee was organized by the election of the following officers: Chairman, Charles F. Scott; secretary, Prof. F. R. Hutton. The chairman was directed to indicate to Mr. Carnegie the acceptance of his gift by the joint committee representing the several organizations.

The joint committee placed the immediate work of developing plans upon an executive committee of five, consisting of one member from each of the five organizations named in Mr. Carnegie's letter, as follows:

American Society of Civil Engineers, Mr. Alfred Noble.

American Society of Mechanical Engineers, Prof. F. R. Hutton.

American Institute of Mining Engineers, Mr. A. R. Ledoux.

American Institute of Electrical Engineers, Mr. Charles F. Scott.

Engineers' Club, Mr. W. M. Fletcher.

The Executive Committee met on May 19 and organized by the election of Charles F. Scott, chairman, and F. R. Hutton, secretary. The committee laid out certain work to be undertaken by its several members, and will have meetings from time to time during the summer.

The following cablegram has been sent to Mr. Carnegie: "Andrew Carnegie, Skibo Castle:—Joint committee four organizations formally accepts generous gift Union Building. Executive Committee in session sends greeting and reports progress.—SCOTT."

The Institute Niagara Meeting.

In the last issue of this journal the excellent programme of the Institute meeting at Niagara Falls was given in full, the various papers and different entertainments making a list which occupied a full column. The meeting will be held at the Cataract House on Monday, June 29, and will continue throughout the week until Friday, when joint sessions will be held with the Society for the Promotion of Engineering Education. In addition to the programme thus printed, and which can also be found in the Institute bulletin, it may be added that Mayor Hancock, of Niagara Falls, is to deliver an opening address of welcome on Monday. On Monday afternoon, which had not been filled up with an engagement, a special train upon which lunch will be provided, will take the convention from Niagara Falls as guests of the Gould Storage Battery Company to the neighboring new city of Depew, where the Gould factory is situated, and where the various processes connected with the manufacture of storage batteries will be fully elucidated.

The general committee, of which Prof. George F. Sever is the chairman, and the local committee, of which Mr. H. W. Buck is the chairman, together with the transportation committee, of which Mr. E. H. Mullin is the chairman, have been working very hard in their respective spheres to insure the success of the meeting, and at the present moment it looks as though, with weather favoring, the convention will be one of the very largest that the Institute has ever known. It is the intention of the local committee to get up, and issue, a programme for each day, stating, in addition to the regular lists of papers given in the Institute bulletin, the detail arrangements for the afternoon and evening. This will be independent of the lists of arrivals and the technical programmes issued by the general committee. With regard to the entertainment for Wednesday evening, the local committee is planning a kind of outdoor smoker in the courtyard of the International Hotel with vaudeville performance, music etc.

In connection with the meeting, the committee on papers, of which Dr. Sheldon is chairman, has issued a neat little pamphlet of introductions to discussions around which a good deal of interesting matter should develop. This material comes from the committee on high-tension transmission and embodies data by Mr. Ralph D. Mershon on the grounded wire as a protection against lightning; the operation and maintenance of high-tension underground systems, by Mr. Philip Torchio; by Mr. Henry W. Fisher on electric cables for high-voltage service, and by Mr. H. G. Stott, on the use of automatic means for disconnecting disabled apparatus. Mr. Mershon discusses the theory of lightning stroke and takes up the material dimensions of ground wires, methods of installation and the general results in practice. Mr. Torchio's paper is a valuable contribution, giving the actual results of high-voltage operation, and is based presumably upon the practice of the New York Edison and its subordinate companies. Mr. Torchio enters into a discussion of the principles followed and the use of indicators and protecting devices, as well as special features in the care of cables. Mr. Fisher develops the cable subject even more thoroughly and takes up the question of their manufacture, describing some which he has designed. Other features of his contribution are the installation of cables, and their operation in electric light and power plants. Mr. H. G. Stott's paper may be said to take up from the side of the electric railway manager some of the points touched upon from the lighting standpoint by Mr. Torchio. Mention is made in his memorandum of devices brought out by Mr. L. Andrews, of England, and it is understood that Mr. Leonard Wilson, of the Stanley Company, will attend the convention and show the practical operation of some of these features for the protection of feeders.

Members attending the convention should be careful to obtain certificates on purchasing their railroad tickets one way, so as to obtain the reduction to one-third fare for the return trip. Full details as to this are given in the Institute Bulletin warning members not to ask for receipts, but to secure "certificates" upon which the railroad agents can give the proper guarantee of personal attendance securing the reduction. This privilege has been duly accorded by the various traffic associations, and it is a duty of all members to avail themselves of it, as they all benefit, particularly those traveling long distances.

Atlantic Wireless Messages.

Mr. Vivyan, Marconi's manager in charge of Table Head Station, announces that he is sending messages of different lengths from Table Head to Poldhu, Cornwall, daily, but that the replies are still being received by cable, owing to the installation of new machinery in the England station not yet being completed. Mr. Vivyan says the apparatus at Table Head now works with ease and that the transmission of the messages is attended with the greatest possible success. The Table Head station is also in daily communication with Wellfleet station at Cape Cod. Mr. Marconi is expected in Cape Breton in August. The officials of the Marconi Wireless Telegraph Company of America have received information that the steamship *Deutschland*, of the Hamburg-American Line, has been equipped with Marconi apparatus. Four other ships of this line are to be equipped similarly. Vessels of this line will, therefore, be able to keep in communication with twenty-two transatlantic liners already using such apparatus, and with the shore stations of the system in Europe and America. The *Deutschland*, it will be recalled, was stuck in the mud of the lower bay for twenty-four hours on her last trip out from New York. It now appears that she had wireless apparatus on board, manufactured by a German concern, and was, therefore, not able to get into communication with the shore stations.

Electric Power From the Hudson.

By Alton D. Adams.

SPIER FALLS, on the Hudson, at the foot of Mount McGregor, sixty miles south of Mount Marcy, where the river rises, and forty miles north of Albany, is to yield 32,000 hp for electrical transmission. In volume, this development of electric power is second only to that at Niagara Falls and at Sault Ste. Marie; in length of transmission it is probably not surpassed east of the Rock Mountains. Electric light, power and traction are to be supplied in Albany, Troy, Schenectady, at the General Electric Works and in many smaller places on the way. To effect this development of power the Hudson River is caught between Mount McGregor and another spur of the Adirondacks, raised fifty feet above its ancient bed, and then dropped through water wheels with a head of eighty feet. A stone dam 1,820 ft. long, about 100 ft. in maximum height above bed rock and containing 180,000 cubic yards of masonry is employed to raise the river level. This dam extends down to bed rock across the entire width of the river, and is anchored at each end in the solid ledge of the mountain side. Behind the dam a storage reservoir one-third of a mile wide and five miles long is formed, thus flooding the ancient river banks.

In this way the sights of roads, farms and dwellings will be covered. To provide for the construction of the masonry dam, a temporary one of earth, cribwork and stone was first built a little up stream from the permanent sight. An opening was left in the timber sections of the temporary dam at one side of the river

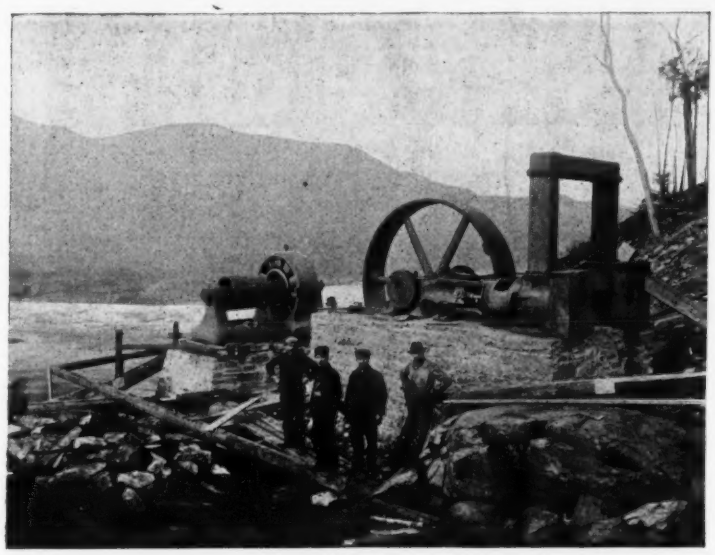


FIG. 1.—GETTING AN AIR COMPRESSOR READY.

so that the water was diverted from its normal course and a great portion of the old river bed at the sight of the permanent dam was left dry. Stone laid in concrete with close joints forms the regular construction of the main dam, though a larger proportion of concrete has been used on a small part of the work. The rule has been to carry the masonry of the dam down to bed rock throughout the entire distance across the river. This has made a large amount of excavation necessary and the cofferdam at one side of the old channel included an area of five acres during one stage of the work and had a maximum height of 90 ft. at one point. Both steam and compressed air have been used extensively on the work, the air compressors being operated by three-phase motors. These motors draw their energy from an electric power station at Mechanicsville, some 23 miles to the south. The new dam, anchored in the mountain ledges at its ends and sunk to bed rock entirely across the river, varies in extreme height according to the different depths at which this rock was found. At one typical section in its overfall part the dam is 59 ft. high above its bed, and 63 ft. up and down stream at its base. Considered as to its length the dam is made up of the river section, of 560 ft., the overfall of 820 ft., and the intake wall of 440 ft., making a total of 1,820 ft. between banks. The overflow portion of the dam must pass water at a very rapid rate during times of flood. At times of minimum flow at Spier Falls the Hudson discharges about 2,000 cubic ft. per second, but during maximum discharge the quantity of water goes up to as much as 50,000 cubic ft. per second. This great variation between high and low water discharge will no doubt be reduced by proposed storage dams at Indian and other lakes about the head waters of the Hudson, in which the State has become interested. The watershed of the Hudson River above Spier Falls has an area of about 27,000 square miles, and the mean, annual flow of the river at these falls is between 6,000 and 7,000 cubic ft. per second. Evidently, when storage

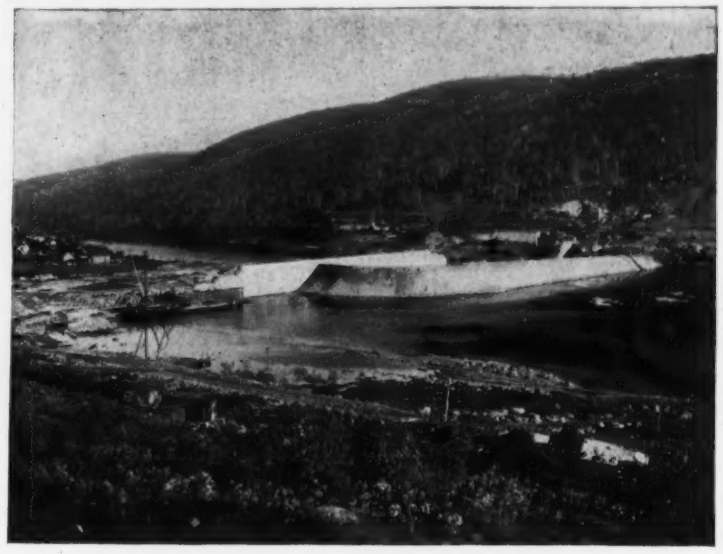


FIG. 2.—CHANGED COURSE OF THE RIVER.

works have brought the minimum discharge of water at the falls up to approximately the mean, annual rate, the amount of available power will be much larger than at present.

Like the dam, the canal and the power house at Spier Falls are built on a natural rock foundation. The short canal is formed by blasting its course into the mountain ledge, and the sight for the power house has been provided by a similar process. The power house itself is one story, of brick, 70 ft. 10 in. x 392 ft. inside, and is located between the canal and the river, a little below the dam. Inside the power house in the direction of its greatest length is a 16-in. brick wall that divides the greater portion of it into two rooms each, 34 ft. 9 in. wide. In that one of these rooms which is nearer the canal are located the water wheels, and the shafts of these wheels extend through the 16-in. brick wall into the room where the electric generators are located. Beneath the floor of the wheel room is an opening 21 ft. 6 in. wide and extending its entire length.

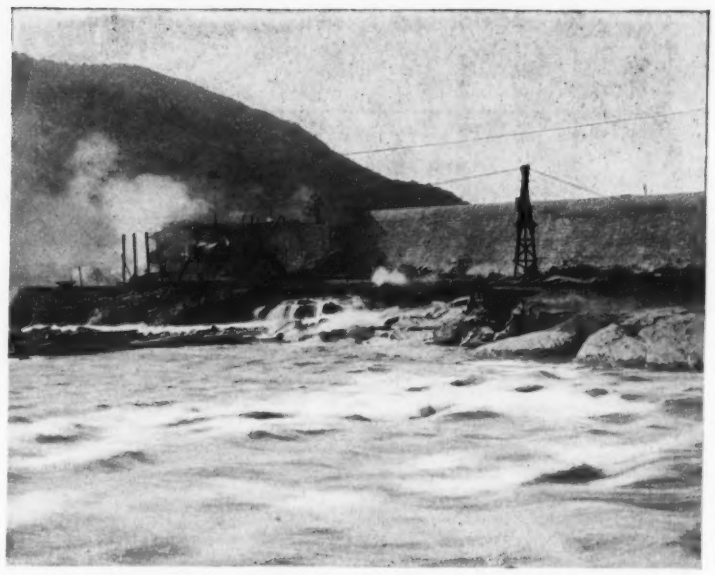


FIG. 3.—PART OF THE OVERFALL SECTION.

Across this opening are placed 36-in. box girders spaced on 14-ft. centers, and between pairs of these girders the water wheels are mounted. Beneath the floor of the generator room a series of arches connect the long chamber beneath the wheels with the space through which the tail water passes on its way to the river. Centers of the wheel and generator shafts are 16 ft. 9 in. above the low level of

FIG. 4.—SITE OF THE POWER HOUSE.

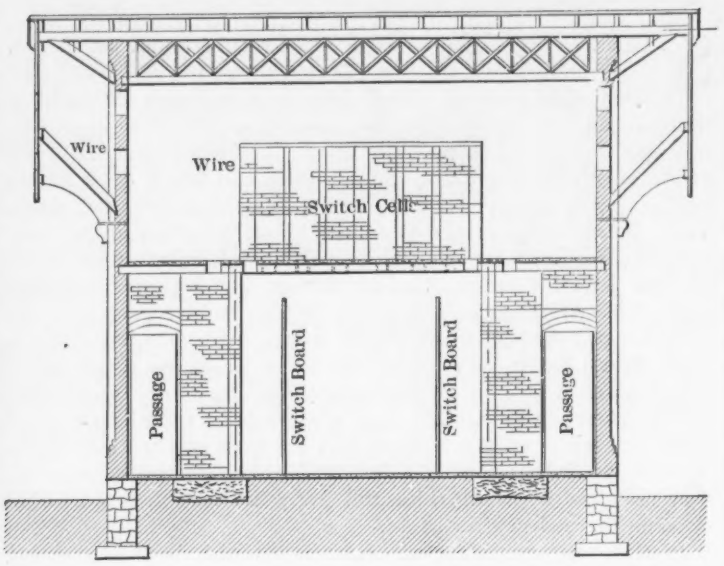


FIG. 7.—CROSS-SECTION OF SWITCH HOUSE.

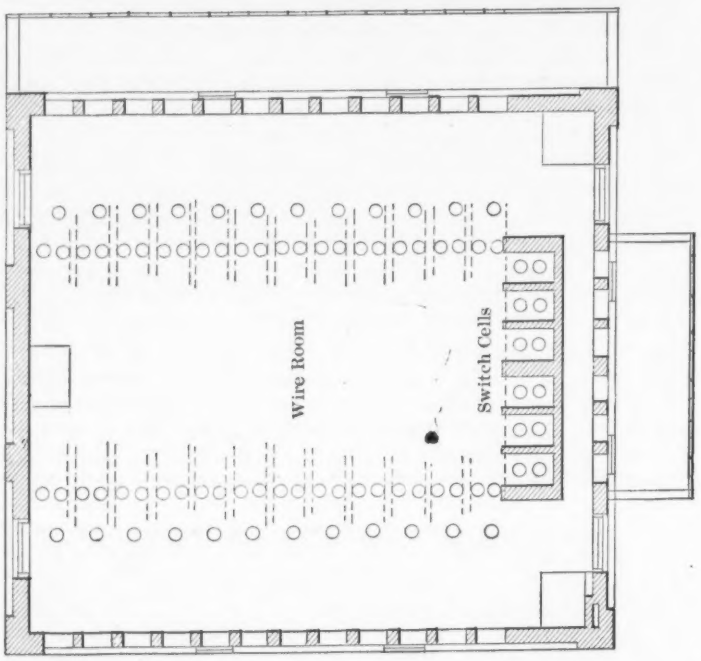


FIG. 5.—SECOND FLOOR PLAN OF SWITCH HOUSE.

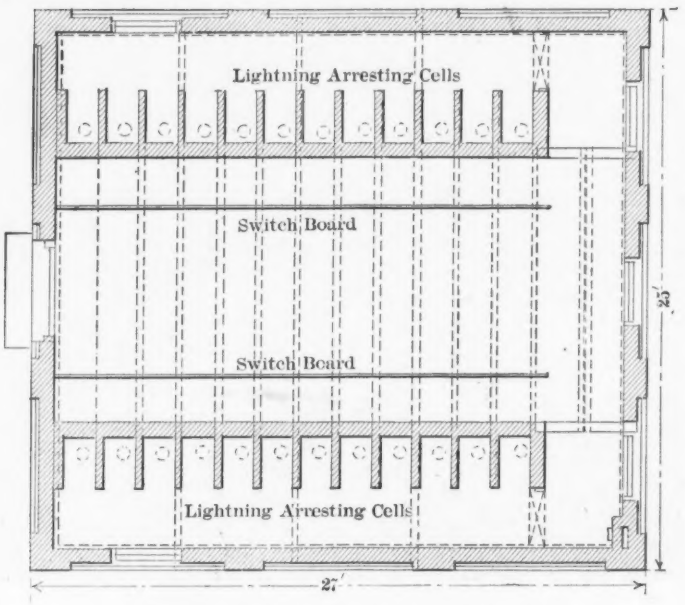


FIG. 8.—GROUND FLOOR PLAN OF SWITCH HOUSE.

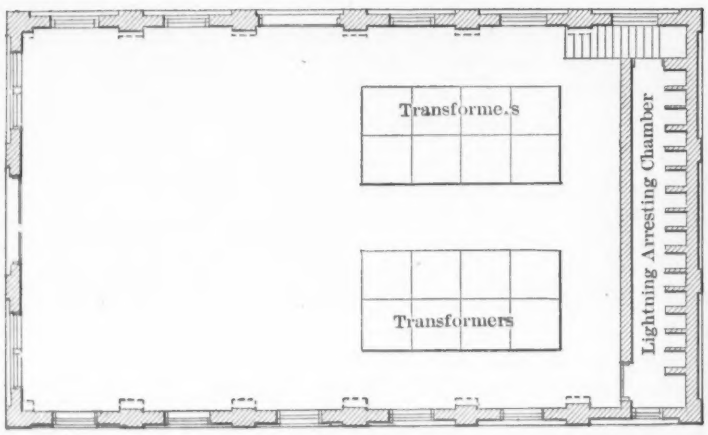


FIG. 6.—FLOOR PLAN OF SUB-STATION.

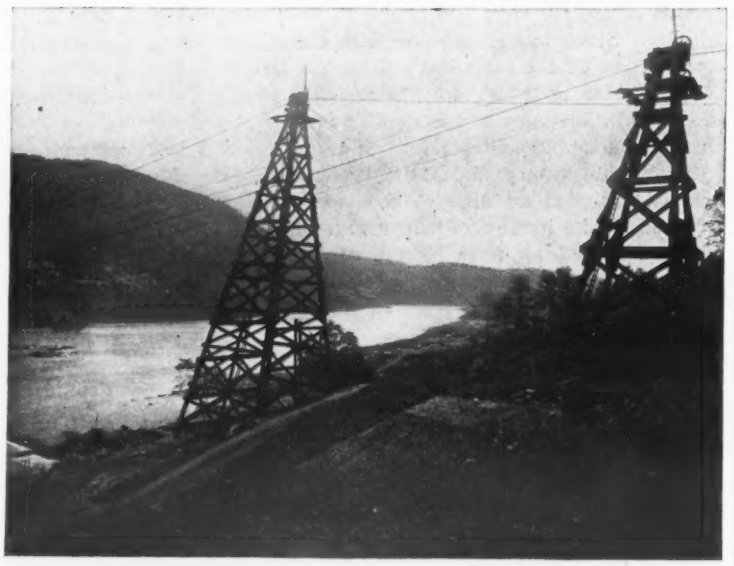


FIG. 9.—THE VALLEY TO BE FLOODED.

ELECTRIC POWER FROM THE HUDSON.

tail water, and the floors of the wheel and generator rooms are 9 ft. 9 in. above this tail water level. One crane mounted between the 16-in. interior and an outside wall sweeps the length of the generator room, and another crane supported in a similar way travels over the wheels.

From floor to the lower cords of the roof trusses the height in the wheel and generator rooms alike is 39 ft. 3 in. At one end of the power station a space extending across its entire width and about 46 ft. long is devoted to the step-up transformers and to the switchboard.

Water passes from the canal to the power house through ten steel tubes of 12 ft. inside diameter each. Before entering the power house these tubes pass through a heavy masonry retaining wall that protects it from water on the side toward the canal. Each of these ten tubes connects with a wheel case that contains a pair of turbine wheels mounted on a horizontal shaft. In each of eight of these cases the pair of turbines is rated at 5,000 hp under a head of 80 ft., and in each of the other two cases the pair of wheels is rated at 3,400 hp. Each of the eight pairs of larger wheels will drive a direct-connected electric generator rated at 2,500 kw, and each of the two pairs of smaller wheels will drive a 2,000-kw generator. All of these generators are of the revolving magnet type, three-phase, 40-cycle, and made by the General Electric Company. Each pair of wheels is controlled in speed by a Lombard governor belted to its shaft. To each of the two cases containing the 3,400-hp wheels there is connected a small wheel case whose turbines drive an exciter for the main generators.

From the foregoing it may be noted that the total capacity of main water wheels at this station is 46,800 hp, and the total capacity of main generators 24,000 kw, or 32,000 hp. The three-phase, 40-cycle current from the main generators will be raised in pressure to 26,500 volts by transformers at the main station and thence transmitted to sub-stations located at Glens Falls, Fort Edward, Saratoga, Ballston, Schenectady and Watervliet, and numbering six in all at the present time. Energy from these sub-stations will be supplied for lighting, general power purposes and electric traction. In some cases, as at Saratoga and Ballston, where the local electrical supply systems are owned in common with the transmission system, energy will be distributed from the sub-stations directly to consumers. In other cities and towns, as in Albany, Troy and Schenectady, energy from the sub-stations will be sold to local lighting or traction systems. At Schenectady the sub-station is divided into two distinct parts, one of which will contain apparatus belonging to the General Electric Company, whose works are to utilize a large amount of the transmitted energy, and the other part will be devoted to service in the city. From the sub-station at Watervliet energy will be distributed for lighting, power and traction there, in Troy and in Albany, also for power and lighting in Lansingburg.

At the Glens Falls sub-station the equipment includes four transformers of 500 kw and 40 cycles each, which take current from the line at 26,500 volts and deliver it at 2,300, 2,400 or 2,500 volts as desired. At this sub-station there are two blower sets and one automatic F.R.T. of 45 kw and 150-volts capacity, besides the switchboard equipment. One three-phase feeder enters this sub-station at a pressure of 26,500 volts, and it has 6 outgoing lines for distribution at 2,300 volts each. Among the service supplied in Glens Falls is that of 2,000 hp to motors in a portland cement works. In the Saratoga sub-station the equipment is the same in capacity as that at Glens Falls except that the F. R. T. is lacking.

The plant at Glens Falls and the transmission system just described are the property of the Hudson River Water Power Company, which also owns another undeveloped water power on the same river. This company also own and operate a large water power plant at Mechanicsville on the Hudson, which was described in the ELECTRICAL WORLD of September 3, 1898. As soon as the plant at Spier Falls is completed, the two plants will be connected with the same transmission system. Work on the dam at Spier Falls was begun in June, 1900, and it is expected that the generating station will be ready to deliver 15,000 hp in July of the present year.

In the water power development William Barclay Parsons and George E. Evans have acted as consulting engineers. Charles E. Parsons is chief engineer in charge of the work. To Eugene F. Ashley, president of the Hudson River Water Power Company, the conception and execution of this great generating and transmission system is primarily due. Chief Engineer Parsons and other officials of the company have extended every courtesy for the collection of the above facts.

When the Hudson at Spier Falls and other adjacent points shall have been made to yield up its energy for useful work, electrical supply in the cities named will be largely independent of coal.

A Note on Three-Phase Power Measurement.

BY F. A. FISH.

IT is well enough known that the power of a three-phase circuit may be measured by two wattmeters connected as in Fig. 1. The wattmeter readings will be:

$$W_1 = I_a\ E\ cos\ (\Phi + \Theta_1) \text{ and } W_2 = I_b\ E\ cos\ (\Phi - \Theta_2)$$

In the case of balanced circuits, $I_a = I_b$ and $\Theta_1 = \Theta_2 = 30°$.

In certain cases, notably that of lightly loaded induction motors, the angle $(\Phi + \Theta_1)$ may become greater than 90° and the wattmeter reading, W_1, therefore negative. It sometimes becomes a question, therefore, as to whether W_1 shall be added to or subtracted from W_2 to obtain the true power. In making some measurements recently, the writer kept the series coils of the wattmeters shunted except when taking readings, and it was noted that as the angle of lag was increased, and the readings of one of the wattmeters approached zero, shunting the series coil caused the needle to swing across the zero and give a negative reading. The load in this case happened to be a three-phase synchronous motor and the lag was controlled by the field excitation. On further increasing the lag so that the normal reading was negative and the connections had to be reversed, the effect of shunting the series coil was to *increase* the reading, whereas, so long as the readings were positive, the effect was to *decrease* the reading. These facts at once suggested a means of determining easily whether a wattmeter reading in a doubtful case was positive or negative, and also raised the question as to the theoretical correctness of the method. The following reasoning seems to establish the latter for the given case, although, as will be pointed out, conditions may exist under which it will not hold.

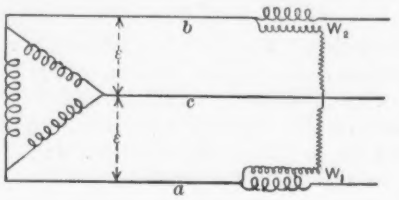


FIG. 1.—DIAGRAM OF CONNECTIONS.

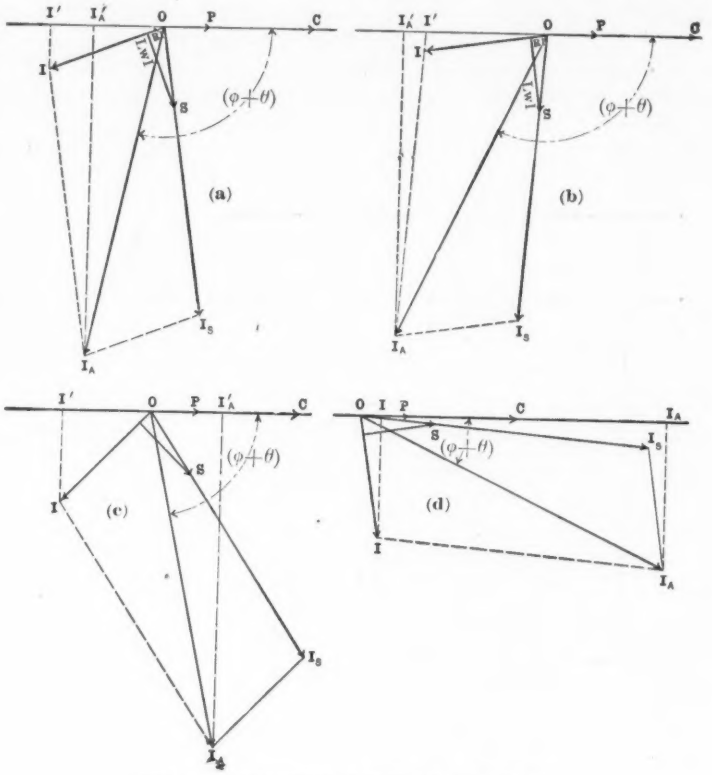


FIG. 2.—MEASURING THREE-PHASE POWER.

In Fig. 2 let $O\,C$ represent the line e.m.f., $O\,P$, in phase therewith, the current through the pressure coil of the wattmeter and $O\,I$ the line current. The product of $O\,P$ and the projection, upon $O\,C$ extended, of the current, $O\,I$, through the series coil will be proportional

to the wattmeter reading. It is evident from the figure that this projection may be larger when the coil is shunted than when not, although the value of the current in the coil will be much smaller. The vector, *O S*, represents the pressure acting on the wattmeter coil and shunt; the current, *O I*, in the series coil will lag behind this by the angle, $tan^{-1}\frac{Lw}{R}$ where Lw and R are the reactance and resistance of the coil; the current, *O Is* will be in phase with *O S*, assuming no reactance in the shunting circuit. It will be observed that while the reactance of the wattmeter coil is not large enough to materially change the line current or its lag angle, its value relative to that of the shunting circuit may be large enough to throw its current considerably behind the current in the shunt circuit, and therefore behind the resultant or line current, since the two latter currents are nearly in phase with each other. It will be further noted that when *O Is* reaches 90° lag behind *O P*, the projections of *O Ia* and *O I* will become equal and the wattmeter reading will not be changed by shunting. If the angle $(\Phi + \Theta)$ increase beyond this limit, the readings will be decreased just as they are for angles less than 90°.

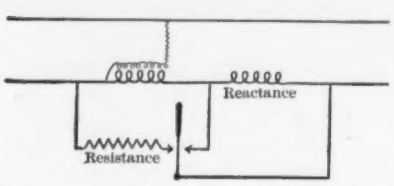


FIG. 3.—COIL IN SERIES WITH WATTMETER.

It is evident that if the shunting resistance be too low the current in the series coil will be decreased so much that the range of usefulness of the principle will be greatly reduced; if the shunting element have a reactance such that the ratio $\frac{Lw}{R}$ for it approaches the corresponding ratio of the series coil, its effect is again lost; and still again, if the reactance of the series coil is much smaller than its resistance the angle between the currents will be so small as to produce no appreciable effect. All three of these objections may be overcome by the single expedient of putting in series with the wattmeter a low-resistance coil of considerable reactance (not enough to materially alter the circuit conditions) and shunt them both with a non-reactive resistance of such a value as to reduce the wattmeter current only to say ½ or ¼ of its line value. Fig. 3 illustrates how this may be done without introducing any material influence on the circuit.

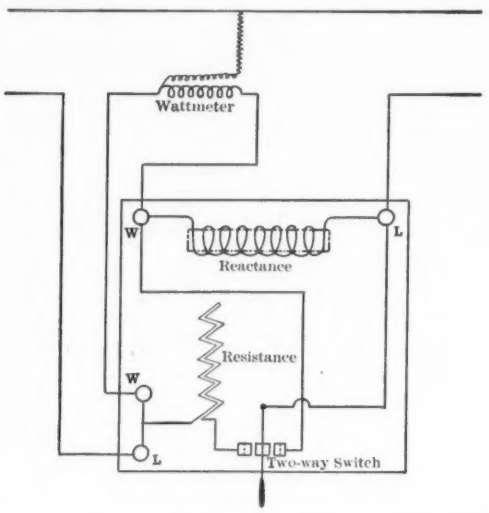


FIG. 4.—DIAGRAM OF SUGGESTED INSTRUMENT.

In order to determine how well ordinary commercial wattmeters would adapt themselves to this method, tests were made on a Weston 7.5-kw and on a Whitney dynamometer type 6-kw instrument. It was found that a shunt of about .004 ohm placed directly on the terminals of the series coil of the Weston would cause an increased reading if the total current lagged between 90° and 94°, while if a reactance of half a dozen turns of heavy wire around an iron wire core about an inch in diameter were put in series and the two shunted with about .02 ohm, the readings would be increased if the current lagged anywhere between 90° and 120°.

In the case of the Whitney, a shunt of about .01 ohm directly across the terminals increased the readings for lags from 90° to 105°, while the introduction of additional reactance and a shunt of .02 ohm caused the readings to be increased until the lag reached about 130°.

It should be remarked that the increase of readings in all these cases amounted to from 10 per cent. to 25 per cent., so that the effect was easily noticeable even where the power was considerably unsteady.

In order to adapt this method to practical purposes, an instrument might be made to be used in connection with the wattmeter, comprising a reactive coil, either with or without iron, a non-reactive resistance and a switch; these to be suitably encased with terminals for connecting to the wattmeter and to the line, and so arranged that in one position of the switch, the reactive coil is short-circuited and the shunt circuit open, and in the other position the reactive coil is thrown in series with the wattmeter coil and the non-reactive resistance is shunted around them. Such an arrangement is shown in diagram in Fig. 4. In case sufficient reactance could be produced without the use of iron, the above combination might well be included in the same case with the wattmeter.

It will have been observed that the underlying principle of the whole scheme is to increase the angle between the current in the pressure coil and that in the series coil of the wattmeter; therefore, if the lead of the former current can be increased, the result will be the same as in the method above described. This, it is found, may be readily accomplished by inserting a suitable capacity in series with the pressure coil.

The diagrams of Fig. 5 show that when $(\Phi + \Theta)$ is less than 90°, i. e., the wattmeter reading is positive, the reading will be decreased by inserting capacity in the pressure circuit, not only on account of reducing the value of the current, but by increasing the angle between the pressure current and the line current; also that when the reading is negative ($[\Phi + \Theta]$ greater than 90°) it may be increased by the introduction of capacity, in spite of a reduction of the value of the current.

It will be understood that, in order to get the best results, the amount of capacity used must be governed by the resistance of the pressure circuit, but in the case of the two wattmeters mentioned above, and also of a Thomson inclined coil wattmeter of 1,600 watts capacity, 2 or 3 microfarads answered about equally well for all of them through a very wide range of lag angles (up to 130°). The increase in the readings by this method was about the same

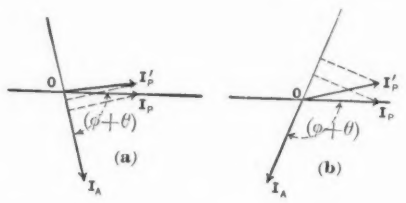


FIG. 5.—EFFECT OF INSERTING CAPACITY.

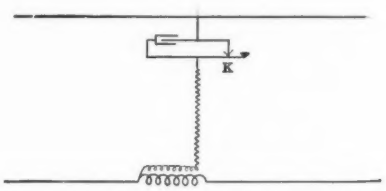


FIG. 6.—DIAGRAM OF CONNECTIONS.

as for the first method described. When a multiplier had to be used with the wattmeter, the effect was found to be decreased only to a small degree.

In applying this method practically, the condenser might very well be included in the wattmeter case and connections made as in Fig. 6, where *K* represents a key which normally stands closed, but on pressing, introduces the condenser into the pressure circuit. Or the condenser and key may be made up as a separate instrument, as in the other method, and would thus be available for more than one wattmeter.

Union Delegate Blackmail.

Blackmail charges have been brought by officers in New York, with details. Mr. Charles L. Eidlitz, of the special committee appointed by the Building Trades Employers' Association, to take charge of cases of extortion against labor leaders, now states that he had several affidavits in reference to corruption among representatives of the electrical workers. "These affidavits are so strong," said Mr. Eidlitz, "that a committee from the electrical workers did not care to hear them read. They will be presented to the District Attorney."

Telephone Exchanges—V.

BY ARTHUR V. ABBOTT, C. E.

THERE is another property which iron exhibits under magnetic influence, which plays an important rôle when this metal is subjected to rapidly alternating electric currents such as constitute the bulk of the line currents in telephone circuits If a piece of iron entirely in a neutral condition be subjected to a slowly increasing magnetic field, the curve, *A*, in Fig 13,* shows that the flux through the iron gradually increases until it becomes practically saturated and thereafter the flux changes with relative slowness. If after such magnetization the magnetizing force is decreased to zero, it is found that the iron does not at once return to its original condition, but on the contrary retains more or less of the magnetism which it has acquired, and that in order to destroy this magnetism, and to enable the piece to assume its original condition of neutrality, a very sensible amount of *demagnetizing* force must be applied. Fig. 15

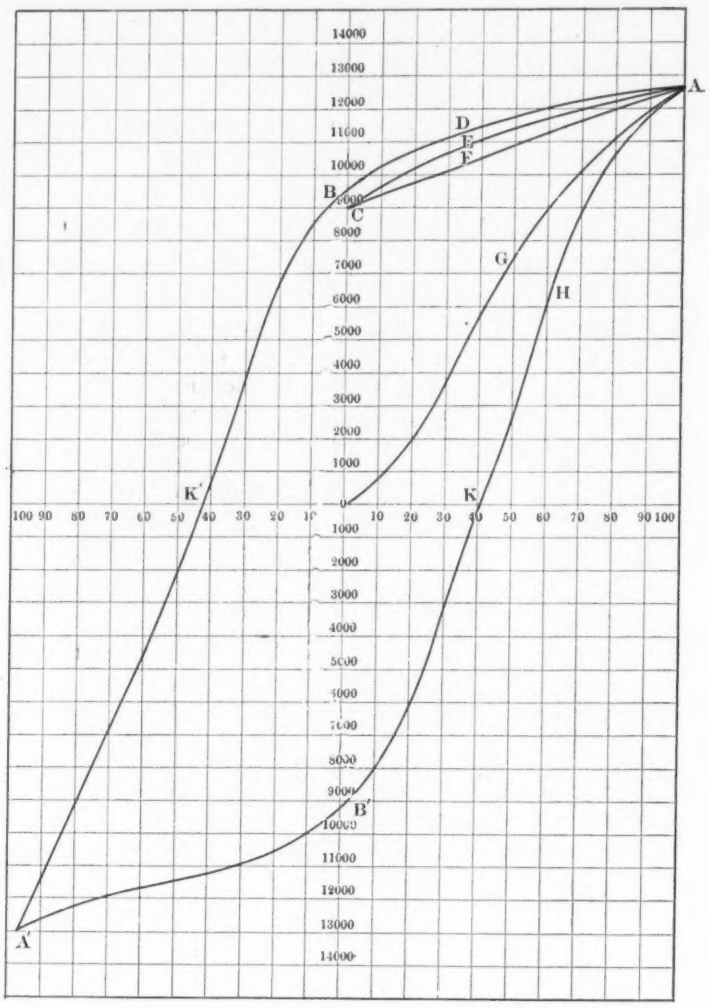


FIG. 15.—MAGNETIC CYCLE FOR STEEL.

is an illustration of the way in which a piece of steel behaves under changing magnetic conditions. In this illustration the horizontal scale shows the magnetomotive force, $\mathfrak{H}$, while the vertical scale indicates the resulting flux, $\mathfrak{B}$. These scales are plotted from zero in the center of the diagram to show both positive and negative values. If we imagine a piece of neutral metal placed in space containing no magnetic field, its condition will be represented by the zero point of the diagram, and if now a magnetic force, $\mathfrak{H}$ (by a coil and battery) be gradually applied and increased as represented along the axis of *X*, the induction will follow the line *O G A*, which is similar to the *A* curve shown in Fig. 13. Suppose, when the magnetizing force reaches 100 that it be gradually decreased in the same manner that it was applied, it is then found that the induction in the metal does not return along the line *A G O*, but on the contrary decreases much less rapidly than it rose. With the first application of magnetic field, when $\mathfrak{H}$ reached 10, the induction was 800; at 30 it was 3,750; at 70 it was 10,100, and rose to 12,700 at $\mathfrak{H} = 100$. Let us suppose at this point that the magnetizing force be arrested and decreased at exactly the same rate that it was originally applied, under these circumstances the induction instead of returning the same way, along the line *A G O*, follows quite a different path, *A D B*, and even when the magnetizing force has been reduced to 0, remains at 9,500. Now, in order to return the piece to its original neutral condition, it is necessary to apply a negative magnetizing force, represented by *O K'*, and as this force increases the induction falls along the line *B K'*, so that the bar does not finally reach its original state until a negative force of 40 has been applied. If now the negative magnetizing force be still further increased a negative induction is created and the piece passes through similar magnetic cycle on the negative side of the axis of *X*. If we imagine the magnetizing force to continually vary from positive to negative in the manner indicated, the magnetic condition of the iron will follow in a series of cycles that are graphically represented by *A K' A' K A*. Evidently to cause the metal to pass through this cyclical change requires an expenditure of energy, which is derived from the electric current that excites and maintains the changing magnetic field, and the area of the diagram shows the amount of energy which is thus expended in doing internal work upon the molecules. The result of this work is to set up some obscure form of molecular friction that manifests itself as heat, and under long-continued and rapidly alternating magnetomotive forces, pieces of iron become intensely hot. This energy is dissipated by radiation and cannot be usefully employed in any electromagnetic mechanisms. The reader will at once argue that a bit of soft iron will thus waste much less energy than hardened steel. Such is precisely the verdict of experiment, and in Fig. 16 a portion of a similar curve is shown for a piece of soft iron. To save space Fig. 16 only includes the portion of the curve on the positive side of the *X* axis. The vertical scale is exactly the same as in Fig. 15, but the horizontal scale is magnified ten times. If this were not done the loop formed by the rising and falling lines of

FIG. 16.—MAGNETIC CYCLE FOR SOFT IRON.

magnetization would be so close together for the iron as to be almost imperceptible because to produce an induction of 12,500 in steel required 100 gausses, but in the iron only 8, and it is easy to see by inspection that the steel loop averages nearly twenty times as wide as the iron one. Evidently the area of such a diagram is a measure of the expenditure of energy employed to perform the magnetic cycle. To this phenomenon Prof. Ewing has given the name of *hysteresis*. In a telephone receiver it is the function of the line current to create alternating magnetomotive forces by the coil which surrounds the magnetic system, and it is obvious that a certain amount of this energy must, therefore, be dissipated in the hysteretic losses in the material that forms the magnets. As the magnetomotive forces developed by the line currents are very small in comparison with the magnetomotive force of the entire magnetic system of the receiver, it is impossible for them to carry the magnet through a complete hysteretic cycle, such as is shown in Figs. 15 and 16. But the iron is carried through a small portion of such a cycle, which is represented in both illustrations by the loop *A E C F A*. Thus

* See page 1011, June 13, for this figure.

suppose, in Fig. 15, that after the magnetomotive force has reached an intensity of 100, it be reduced to 0, and then be increased to 100, the flux will follow the path *A E C F A*. Similarly in Fig. 16, if the magnetomotive force be carried to 15, then decreased to zero and then increased again to 15, the induction follows the line *A E C F A* on that diagram, and an amount of energy which is represented by the areas of these loops will be dissipated. While such losses are small they are significant when it is remembered that the energy developed in the line current is exceedingly minute, and it is only by the exercise of the greatest possible economy in losses in every direction that improvement in telephone receivers can be made. So it is desirable to secure for the magnetic system such a metal as will show the highest degree of sensitiveness to the feeble line currents, and will simultaneously waste the smallest fraction of this energy in hysteresis.

The curves of Figs. 13, 15 and 16 show that soft iron is much more sensitive to slight changes in magnetism; exhibits a much smaller opposition to magnetic flux; and dissipates far less energy in hysteresis than steel. Some of the earlier forms of receivers were arranged to have one pole of the magnets carry the line coil, while the other was attached to the diaphragm. This design comprised a magnetic system having great reluctance and large hysteretic losses. As one pole was magnetically attached to the diaphragm, the latter, unless very thick, became supersaturated with the flux from the magnet, and was correspondingly insensitive to the field variations produced by the line current. We are now in a position to understand the logic of the later models in which the magnet carries *two soft iron pole* pieces on which the field coils are wound. The office of the magnet is to create such a field as will maintain all of the magnetic system in its most sensitive condition or state of unstable magnetic equilibrium. Hence the permanent magnet as a generator of the necessary magnetomotive force must have such dimension in relation to the air-gap and diaphragm as will maintain the latter in its most susceptible condition. The proportions of the magnet will, therefore, depend in the thickness and permeability of the pole pieces and diaphragm and the length of the air-gap. The pole pieces form that portion of the magnetic system directly affected by changes in the line current. They must, in addition, transmit to the air-gap the flux created by the permanent magnet that shall, so to speak, sensitize the diaphragm. Hence the pole pieces must have such a section in proportion to permeability as normally to be in the most susceptible condition to respond to the line currents; they must be of such a material as will give the greatest value to μ; and dissipate the least quantity of energy by hysteresis. To make the whole apparatus as sensitive as possible the air-gap must be as short as is consistent to allow the diaphragm to make its greatest range of vibration without actually touching the pole pieces to avoid any blurring of its vibrations and prevent the possibility of magnetic adherence to the pole pieces; lastly, the diaphragm must be designed to contain as large a volume of the most permeable material as is consistent with the acoustic principles to be presently developed. We are now prepared to consider materials and methods of constructing permanent magnets, pole pieces and diaphragms.

Magnetic Pole Expedition.

The whaling ship *Gjoa*, with Capt. Ammundsen's magnetic North Pole expedition sailed from Christiania, Norway, June 17. The expedition will first go to King William's Land, on the eastern coast of Greenland, and will thence proceed for Behring Strait. The expedition was characterized by Prof. Schmidt, of Berlin, as undertaking the most important task in the domain of terrestrial magnetism. It is planned to take a route never before attempted. While it has not been announced that the expedition is designed to reach the Pole, if Capt. Ammundsen is able to follow the course projected it will take him almost directly across the pole. Capt. Ammundsen, who is a Norwegian, was the first officer of the *Belgica* in Gerlach's Antarctic expedition of 1897-99. After his return he consulted with Prof. Neumayer, of Hamburg, the leading authority on terrestrial magnetism, who informed him that expert determination of the earth's magnetic North Pole would be of the very greatest value to science. The fitting out of the expedition which has just left Christiania, followed. The Gjoa is one of the strongest and best vessels of the Arctic fleet. She can be handled by a crew of seven, is fitted with an auxiliary petroleum engine, and is equipped for a four years' stay in the Arctic regions.

Analysis of the Detroit Municipal Lighting Figures.

REPLY OF COMMISSIONER INGRAM AND REJOINDER.

My attention has been called to an "analysis of the seventh annual report of the Public Lighting Commission, Detroit, Mich.", that appears on pages 354 and 359 of your journal of February 28, 1903, occupying 9½ columns. In your editorial discussion of the analysis on the first and second editorial pages of same number you say "nothing permanent is to be gained in it (public lighting) by concealing the facts as to its real cost, by whomsoever produced."

Speaking as one of them, I wish to say, the Public Lighting Commission of Detroit agrees with Dickens, that "facts alone are wanted in life. Plant nothing else and root out everything else." We welcome advice in getting at the real facts and appreciate the assistance offered us by this carefully-written and scholarly criticism of our seventh annual report. The public generally are also entitled to the facts, for to quote Lieut. J. B. Cahoon, past president National Electric Light Association, "Cities are still threshing over the old ground of whether it will pay them to build their own plant to light their own streets" (Municipal Affairs, Vol. VI, No. 4), so I respectfully ask that you give the following statement the same publicity you did the analysis above referred to:

THE NUMBER OF LAMPS.

The average number of arc lamps in use, according to seventh annual report, was 2,133; the analysis claims the correct number should have been 2,082. This claim is made by assuming that one-half of 58 lamps on Belle Isle should be deducted from the average number of arc lamps, because the lamps on Belle Isle do not burn after midnight, also deducting "22 lamps in buildings," making a total of 51.

The average number of arc lamps in operation on Belle Isle for the year was 37. If it is reasonable to deduct one-half the number of lamps because they burn but half the time, the deduction should be one-half of 37, not one-half of 58, but since the total operating expense for the past six years averages 70 per cent., as fixed, and 30 per cent., as variable, one-half of the variable expense only should be deducted, which leaves 85 per cent. as the cost of operating these lamps; 85 per cent. of 37 is 31.45 lamps on Belle Isle.

The number of lamps in station is seven. The balance are located, 5 on Belle Isle Dock, 3 in Western Market, 4 in Eastern Market, lighting surrounding streets, as well as the sheds; 2 in Waterworks, and 1 in City Hall; all are operated all night and would be, if under contract; therefore, to deduct these 15 is plainly an error. As regards the "22 lamps in buildings," from the critic's point of view, comparing the cost with public lights furnished under contract, the lamps in station should properly be deducted, for there need be no station if lights were contracted for.

From average number of arc lamps (page 9, 2,133), deduct 5½ to bring the average number of lamps on Belle Isle to 31½, and 7 for lamps used in Public Lighting Plant, leaving 2.133 less 12½, or 2.120½, as the actual average, which, used as the divisor, makes the cost of an arc lamp $64.20, not $65.32, as stated in analysis.

DEPRECIATION.

The charge of 3 per cent. on total investment for depreciation is ample to take care of same considering the fact that the cost of maintenance and replacement, are charged to operating cost, and the plant is kept in first-class condition, while items figure in operating cost that could be charged to extensions, as they go to extend our lines, some of which I will refer to later.

Depreciation is always debatable ground, as for instance to again quote Lieut. Cahoon, of the National Electric Light Association, in speaking of private electric light companies (page 646 *ibed*), he says: "What profits were made were promptly paid out in dividends, and nothing was set aside for the replacement of apparatus. Depreciation was never thought of; hence, the burden on the electric light plant is much heavier than on any other form of manufacturing plant." There is and has been no motive for this policy in reference to Detroit's Public Plant, which is not run for such profit, every incentive prompting the management in quite an opposite direction. There is no depreciation that is not taken care of either in the depreciation charge or in the operating expense. Amounts charged to operating cost and expended for maintenance and replacement during the year (7th annual report) (see table on next page).

The amount annually represented by maintenance and replacement included in operating cost and the depreciation charge leaves the cost of lights ($64.20) a very attractive figure when compared with

prices usually charged cities under contract; still it is proving ample to duplicate our lines and apparatus as they need replacement; our

Buildings, track, dock, etc.	$1,616.38
Steam plant	3,070.44
Electric plant	959.05
Miscellaneous tools and machinery	828.11
Conduits	377.73
Towers and lamp posts	974.99
Arc lamps	2,017.68
Lines and cables	4,562.18
Total	$14,406.56
Amount charged off for depreciation	24,073.17
Total for maintenance, replacement and depreciation	$38,479.73

funds for extensions, as shown by report, going to increase capacity.

VALUE OF PLANT

The present net value of the plant is correctly stated in the report, as it is the total cost less the ample depreciation charge explained in preceding paragraph. Our critic is mistaken when he charges that certain items of investment have been done away with, and their value not fully written off, as I will show farther on when discussing the items in detail.

AVERAGE WATTAGE PER LAMP.

For fiscal year covered by seventh annual report, the total hours of lighting (page 26) were 3,744.04. The average number of lamps (page 32) were 2,133, which included 37 lamps burning until mid-night only; consequently being equivalent in kilowatt-hours' consumption to 18½ all-night lamps, so the average number of lamps burning for the full number of hours reported was 2,114½. Dividing the kilowatt-hours mentioned by said number of lamps shows an average per lamp at station of 463.8 watts, deducting from which 9 per cent. for line loss, shows a net wattage per lamp at lamp terminal of 422. This average is about 6 per cent. below the claimed standard of 450 watts for a 2,000-cp lamp, and is the result of the circuits being cut to 9.2 amp. after midnight, a practice which has been followed since the plant was established, the object of same being to save in operating expenses during the latter half of night giving the most light the first half when most needed. The per cent. of saving in cost during the year on account of cutting the circuits to 9.2 amp. after midnight is as follows:

The average kilowatts saved per hour on the entire load is 152.8, which for one-half the total hours per year (1.872) amounts to 286,041.6 kw-hours. The cost of coal and carbons (only items reduced) for the year was $29,293.52, or $.008 per kw-hour, making the actual saving $2,288.33, or 2.3 per cent. of the total operating cost. Dividing this saving by the correct number of lamps, viz., 2,120.5, shows an average per lamp per year of $1.08, adding which to the corrected cost previously given, viz., $64.20, makes the cost for 2,000-cp all night, $65.28.

INCREASE OF LIGHTS.

Percentages of increase to extension of incandescent and arc lighting system mentioned on page 11 has reference to the number of arc lights, incandescent lights and motors installed during the year, and not to the output, and is correct. On June 30, 1901, the total number of incandescent lamps in public buildings was 6,948, including the lamps used in decorating and in welcome sign on City Hall. On June 30, 1902, the total number of incandescent lamps in public buildings was 11,780, being an increase during the year of over 69 per cent. There was also placed in public buildings during the year 12 motors with a total of 35 hp, which is equal to 350 incandescent lamps, making the increase in incandescent service over 74 per cent.

On June 30, 1901, the total number of arc lamps in operation was 2,042; during the year there was installed 260, making the total number of arc lamps in operation on June 30, 1902, 2,302, being an increase for the year of over 12 per cent.

COLLECTIONS FROM RENTALS, ETC.

In reply to criticism of the discrepancy in the amount received from rentals would say that this was an error, the letters, etc., having dropped out of copy for page 10 was passed at final proof reading, omission not noticed. The amount, $6,775.61, is correct, being the exact sum of the three items mentioned on page 70, and was received from sale of old material, incandescent lighting and rentals

COST OF PLANT PER ARC LAMP.

In reply to the statement that the cost of plant per arc lamp should be $340.37 instead of $263.35, as given in seventh annual report of the Commission (page 24), would say that the electrical capacity of the plant is as stated in report, 2,745 arc lamps, machinery and apparatus being in first-class condition, and capable of operating 2,745 arc lamps, and not of junk value, as claimed by critic; and on the capacity of the plant the cost as stated, $263.35, is correct. By allowing a certain portion of the plant as a reserve, as for instance computing the cost on the maximum number of arc lamps operated, the cost of course would be correspondingly more and is as stated, $340.37.

The plant capacity given in the fourth annual report is	1,337.5	K.W.
Purchased since:		
One 600-K.W. alternator		
One 175-K.W. Alternator		
One 7-K.W. Brush arc	782	K.W.
Total	2,119.5	K.W.
Sold 3 55-K.W. Westinghouse, 40 cycles	165	K.W.
On hand	1,954.5	K.W.

JUGGLING OF ACCOUNTS.

The inference our critic makes that funds appropriated for extensions and betterment have been used for operating expenses is ungenerous, for had he desired to know the facts before making his comments he could have ascertained them at our office without trouble, delay or expense. It is a public office and all such requests

"ABANDONED" POLE LINE MUNICIPAL LIGHTING IN DETROIT, MICH.

made in person or by mail receive due attention. It is public property, as accessible to all as to the Commission or its employees.

The kilowatt-capacity of the plant is correct at 1,954.5, as given in the seventh annual report. The item in the fourth annual report referred to by the writer of the article in THE WORLD AND ENGINEER, is the sum of $41,945, which was allowed for extension of the arc and incandescent service. The arc lamps and incandescent service were put in, but the machinery was not purchased, which left a balance of $29,000 in the Public Lighting Fund, with which in 1901 775 kw was purchased at a cost of $35,865; the balance, $6,865, was taken from the surplus from appropriation for the operation of the plant.

The $37,000 appropriated for year 1902 for the purchase of machinery has not been expended, as the machinery will not be delivered before July, 1903.

LOST TAXES.

Under this head complaint is made because we use the term "probable assessed value." As stated in the sentence of which the above quotation is a part, "lost taxes are based upon a comparison with the assessed values of other plants of like character, similarly located in the city," this comparison was made by the city assessors and the Commission, and the sum for city, county and State taxes, as given in the report, was decided upon without bias, and I believe is fair. However, I submit herewith a statement showing the amount of taxes paid by the Edison Illuminating Company, of this city, for the same fiscal year, together with its kilowatt capacity and the rate of tax per kilowatt capacity. Also the amount added by the Public Lighting Commission in the seventh annual report on account of lost taxes, the kilowatt capacity of the public plant and the rate of tax per kilowatt capacity, and also the amount overcharged the Public Lighting Commission in comparison to the rate per kilowatt capacity as paid by the Edison Illuminating Company.

Edison Illuminating Company:	
Taxes	$12,490.67
K. W. capacity	5,257
Tax rate per K. W. capacity	2.37
Public lighting commission:	
Lost taxes, added	$8,262.35
K. W. capacity	1,954½
Tax rate per K. W. capacity	4.23
The amount the Public Lighting Commission would have charged if at the same rate per K. W. capacity as paid by the Edison Illuminating Company	$4,622.16
Lost taxes added to cost of arc lamp in seventh annual report exceeds actual taxes paid by the Edison Illuminating Company of this city on proportional capacity	3,640.19

Again, by comparing our charge for lost taxes with the taxes actually paid by the private company which last furnished the city its lights, and which probably would still be furnishing the city its lights had the city not installed its own plant, for they were the lowest bidders on a 10-year contract, it is found, making due allowance for increase that the charge is more than ample.

INCREASE IN "OUTAGES."

It is true the "outages" increased during the year covered by the seventh annual report over the preceding due to interruptions of service while changing a part of the street lighting system from direct-current, open-arc to the series-enclosed alternating, and did not result from our reduction in the cost of maintenance, as claimed. Our records show that this exceptional condition accounts for 75 per cent. of the "outages" for the year.

The following tables give the average number of lamps, total lamp-hours out and average lamp-hour out per lamp per year, for the fiscal years 1897 to 1901, inclusive, as operated by the Public Lighting Commission. Also the total number of lamps operated, total lamp-hours out and average lamp-hour out per lamp per year for the last year the city was lighted by contract.

Public Lighting Commission.

Year.	Av. No. Lamps.	T't'l lamp hrs. out.	Av. No. lamp hrs. out per lamp per year.
1897	1.744	7.465 hrs. 23 min.	4 hrs. 17 min.
1898	1.868	5.039 hrs. 43 min.	2 hrs. 42 min.
1899	1.963	6.138 hrs. 55 min.	3 hrs. 07 min.
1900	2.035	4.092 hrs. 19 min.	2 hrs. 00 min.
1901	2.133	6.825 hrs. 19 min.	3 hrs. 12 min.
Contract:			
1894	1.279	100.880 hrs. 00 min.	79 hrs. 00 min.

WAGES CORRECTLY DISTRIBUTED.

The total wages charged to maintenance and repairs as published in seventh annual report is correct. On page 40 of the seventh annual report of the Commission, under the head "Maintenance and Repairs," is a list of employees, but among this list are the following: One conduit man, 1 conduit helper, 1 line foreman, 5 linemen, 1 line helper, 1 ground man, all of whom not only work on maintenance and repairs to lines and cables, but also do all construction work done on lines and cables. Some of the other employees in this list also work on construction work at times, namely, the blacksmith, latheman, painter, and, in fact, all the employees mentioned in article, do more or less work on construction during the year. The employees mentioned in seventh annual report were those in the employ of the Commission on June 30, 1902, and do not include all the men employed by the Commission on this work during the year.

There was installed by our employees during the year in question 260 street arc lamps and service was connected to 36 public buildings.

The following tables give the correct amounts paid for labor on account of construction and maintenance and repairs, and agrees with time cards for the fiscal year ending June 30, 1902:

Month.	Maintenance and repairs.	Construction.
July	$445.98	$5,763.58
August	632.62	1,007.85
September	526.67	1,163.05
October	927.61	1,133.97
November	678.07	1,192.48
December	748.77	663.00
January	711.71	709.65
February	848.78	409.19
March	1,117.34	102.19
April	994.62	226.15
May	1,115.35	189.49
June	967.96	341.66
Totals	$9,715.48	$12,902.26

COSTLY POLE LINE WAS NOT ABANDONED.

In reply to the statement that one costly pole line has been practically abandoned, would say that this must have reference to our west side pole line, which carried a number of circuits, some of which have been transferred to conduits. Only the cable purchased for the conduits was charged to extensions, the labor and other material for installing same was charged to maintenance, as was also the time consumed in transferring such wires as were transferred from the poles to other lines. The poles and the balance of these wires that were on them are still in use, no wires or poles have been discarded. They are now being used for local purposes.

THE $100,000 SENSATION.

In replying to the statement that the Commission are now discarding $100,000 worth of machinery and lamps, would say the facts are, the only machinery discarded were three 55-kw alternators, two 100-light, direct-current arc machines, and 225 open direct-current arc lamps, all of which originally cost $11,425. They were sold for $2,772.89. Add to this the 3 per cent., which was charged off annually for seven years, which amounts to $2,399.25, shows a loss of $6,252.86, which will be charged to operation this year, and next as withdrawn and delivered to purchaser, but will be largely offset by the reduction in operating expense resulting from the change.

MISLEADING STATEMENTS.

In commenting on this statement made on page 10 of report, "A saving of expenditure formerly made by other agencies of the city government and now saved by virtue of the existence of this Commission, makes a further reduction in cash cost." Our critic says, the statement is misleading and incorrect. Since no such deduction figures in the challenged cash cost per arc, as given on page 9 of the report, I leave the reader to decide who it is that is attempting to mislead.

But since he has raised the question: has the city saved in doing its own lighting the sum $1,200 he wrongully infers has been deducted from the amount given as the cash cost per year?

Contracts for public service do not enforce themselves, and even though all the agencies of the city government that can be brought to bear upon the contractors are appealed to, the result as seen in the history of contract lighting is sometimes disappointing. Bribery, bargains and boodle too often become a factor in city lighting, as it was in the closing hours of contract lighting in this city, and is now in some cities, as witness the following dispatch in *Detroit Free Press*, dated Saginaw, Mich., May 10:

"The grand jury, as reported Saturday night, returned a grist of indictments.

"Alderman James Lester—Two indictments; accepting a bribe in connection with the electric lighting deal and offering $5,000 bribe to Thomas Nickels in the bridge matter.

"Alderman Frank Starkweather—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman James Willhite—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman Lave M. Stine—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman John Heman—Bribing Aldermen McCrea, Stine and Willhite in connection with the electric lighting deal.

"Ex-Alderman Fred C. Peters—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman Charles H. Bird—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman James McCrea—Accepting bribe in connection with the electric lighting deal."

Again:

Is $1,200 an unreasonable sum to expend in sustaining cities' rights under a lighting contract when the outage the last full year in Detroit with contract lighting was over $100,000 with 1,279 lights burning, and was less than $7,000 the reported year under public lighting, though there were over 2,000 lights burning?

THE INVESTMENT VIEWPOINT.

In reply to the statement that Detroit's municipal lighting plant is earning the city 4 per cent. on the investment, I will quote Mr. Joseph E. Lockwood, president of the Michigan Electric Company, who, I am sure, it will be conceded, is without bias, and whose long experience in the electric field makes him a competent authority. It is a summary of a carefully prepared paper that goes into minute details and is too long for repetition here, but is commended to those interested, and appears on pages 825-834 Municipal Affairs, Vol. 6, No. 4, and shows "the entire plant will be a clear profit to the city by July 1, 1905, ten years from the starting of the plant, it will have saved the city of Detroit enough to retire its entire bonded debt."

Mr. Lockwood considers all cash outlay, including interest and allowance for lost taxes and all other possible costs or charges, so after July 1 of that year costs may be justly computed without any interest allowance in comparing with what would have to be paid a private company, which if financed, as is usual, the public would be compelled to pay at least 5 per cent. on bonds, equaling in amount the full value of the plant, and in addition thereto a handsome profit to the stockholders on watered stock (see also remarks of Lieut. Cahoon, ex-president National Electric Light Association, Municipal Affairs, Vol. VI, No. 4, page 839).

We thank our critic for his carefully-prepared paper and will profit in future through his discoveries. In turn we hope those who wish "to form their minds upon facts" will be the gainers by this farther contribution to the discussion. In closing I wish to inform the editor, who says (page 345), "we have not the least prejudice. Our exposure of the facts in this case may seem merciless, but it is better for the public that they should come out without reserve," that such extraordinary devotion to the public as is here confessed deserves applause, and if the commissioners must suffer because the editor's heart is closed to mercy, they will try to be brave and will even also applaud if the deviations from strict and proper business methods in our accounting will also "come out," and we are shown specifically, not by general insinuation and innuendo what there is wrong about our bookkeeping.

While the criticism has shown some trifling errors which we cheerfully acknowledge, they are petty and of no consequence when considering the general result. After making every allowance for error, the total cost per 2,000-cp arc lamp per year from Detroit's public plant is $65.28, not "$80, probably more," as stated in the analysis. As for the quality, I have shown a great improvement, the outages the last year of contract lighting being over 25 times as many per lamp per year as the average annual outages from the public plant.

The tax charge added to cost per light by Detroit's public plant is, as I have shown, a greater sum than the taxes paid per light by the private company that last lighted Detroit's streets, while it is nearly double the tax paid, proportioned to capacity, by the Detroit Edison Company, for the year covered by the seventh annual report.

Due regard for the facts leaves no basis for the charge that wages are misapplied, or that depreciation is not fully taken care of, and after all is said, the fact remains that Detroit, by owning and operating its own electric plant, has greatly improved the service and will have saved enough over best ten-year contract price offered to more than retire its bonded debt within that period. Thus adding the entire plant worth, $800,000, to the profit of the undertaking.

DETROIT, MICH., May 18, 1903. FREDERICK F. INGRAM.

THE REJOINDER.

We are glad to give publicity to Commissioner Frederick F. Ingram's comment on our review published February 28. To the extent that his communication explains the obscurities and discrepancies of the Public Lighting Commission's Seventh Annual Report, it is a welcome addition to the existing fund of information. For such explanations and revisions as he has furnished, we thank him.

LAMPS ON BELLE ISLE.

Some of his figures, nevertheless, require further elucidation. His statement that the average number of lamps on Belle Isle for the year was 37 does not agree at all with the figures of the report. On page 29 it is printed that on June 30, 1901, there were 62 lamps on Belle Isle, and on June 30, 1902, 58 lamps. On page 35 the lamps on the Belle Isle circuit, not including any lamps in buildings, are listed as 62. We fail to see how these figures average 37, nor do we find that the average figure was used by the Public Lighting Commission as a divisor.

As to the lamps on Belle Isle dock, which Mr. Ingram says are operated all night, our information still is that these lamps only burn until midnight during the summer and not at all during the winter; and Mr. Ingram does not notice at all the apparent double credit for their operation.

Neither can we accept Mr. Ingram's further averaging by the introduction of fixed and variable costs unless the Commission will take account of fixed and variable costs systematically in all its public statements.

DEPRECIATION.

We admit that "depreciation" is debatable ground so long as it is figured from theoretical premises. We have invited the Public Lighting Commission of Detroit to take the depreciation of their plant out of the realm of uncertainty into that of certainty by making a proper inventory of the plant and comparing that with the book value.

Mr. Ingram's statement that there is no depreciation not taken care of either in the depreciation charge or in the operating expense, adds nothing to the evidence. It is merely his personal reiteration of the statements which he and five other commissioners have officially made. Unofficially, as well as officially, Mr. Ingram continues to avoid the only business-like way of showing whether the depreciation charge made by the Public Lighting Commission is sufficient; namely, the making of a systematic inventory of the property.

The opinion of Mr. Joseph E. Lockwood does not help the case. It also is merely an opinion. But if Mr. Lockwood is to be quoted by Mr. Ingram, he may also be quoted by us. In the paper to which Mr. Ingram refers (see *Detroit Free Press,* March 11, 1903), Mr. Lockwood suggests to the Commission the advisability of doing away with the 1,800 direct-current lamps, which have been in use for the last seven years, and the substitution of enclosed arc lamps. He recommends that the Commission ask for the issue of $150,000 worth of bonds to make the exchange. A condition of affairs which in the opinion of the engineer commended by Mr. Ingram now warrants the issue of $150,000 worth of bonds to make replacements, does not coincide with Mr. Ingram's claim that the depreciation charge heretofore made is sufficient. This replacement would almost wipe out the entire depreciation charge of the first seven years; and the proposed charge to capital account seems a rather desperate expedient.

OTHER QUESTIONS OF FACT.

Our reviewer takes issue with Mr. Ingram on matters of fact as well as matters of figures. He insists that the costly pole line to which he referred is really abandoned, and he sends us the annexed photographs showing its present condition. It formerly carried all the circuits for the western half of the city. The pictures show that it now does very little. He also quotes Mr. Ingram as authority for the bad condition of the pole line; referring to the *Detroit Sunday Tribune,* of November 18, 1900, in which Mr. Ingram over his own signature wrote as follows:

"Our superintendent had recommended that inasmuch as our main lines east and west within the half mile circuit were in bad condition they should be drawn into the conduits and the poles removed. Investigating, we found the conduits built, but not in use; the western

poles rotten and dangerous and rebuilding necessary; but that the eastern line could stand another year. Therefore, we had the western line put into the conduits where it belonged."

It appears that while the line can carry the few wires still left on it, it had to be relieved of the work for which it was built; and that the cables which were put underground, while in a sense they were a betterment, did not add in any way to the distributing capacity of the plant. In our opinion the Commission should not have charged even the cost of cable entirely to extensions.

Mr. Lockwood's paper referred to is also a corroboration of our reviewer's statement that much of the original equipment of the plant is being abandoned. Certain it is that the Public Lighting Commission has replaced many Brush open direct-current lamps by alternating enclosed lamps. The general understanding is that this action is part of such a continuous plan as is outlined by Mr. Lockwood. Mr. Ingram's figures under the head of "The $100,000 Sensation" are also questioned by our reviewer, who says that the apparatus listed by Mr. Ingram cost the Commission a good deal more than the $11,425 which Mr. Ingram quotes as its original price.

His figures are:

2 100 light dynamos at $2,292.00	$4,584.00
225 arc lights at $23.00	5,175.00
3 55-K.W. alternators, slow speed at $2,125.00	6,375.00
	$16,134.00

To which must be added the cost of foundations, of setting up and connecting.

This question can be settled by reference to the Commission's original records. The difference would not affect the general result, but our challenge of Mr. Ingram's accuracy invites a response from him.

BRIBERY AND CORRUPTION.

Mr. Ingram's reference to certain indictments of aldermen of Saginaw, Mich., although apropos, is not argument. Does Mr. Ingram expect us to believe that aldermen are always honest when public lighting is done by a municipal plant, and always dishonest when public lighting is done by contract? If so, will he kindly let us know why the aldermen of the city of Detroit are not permitted to manage the Public Lighting Plant of that city? Why, in fact, he and five other public-spirited gentlemen are appointed to give their time, worth a good deal, without salary, to the performance of duties which ought to be entrusted to the elected and paid servants of the city? This reference recalls to us that there was more than one scandal connected with the early days of the Public Lighting Plant of the city of Detroit, and that his predecessors presented to the Michigan State Legislature of 1895 such showings of corrupt practices that the Legislature withdrew from the Common Council of the city the right to confirm or to disapprove contracts for public lighting apparatus and supplies. To us it appears that honest men will be honest whether they be officers of a public or a private corporation. We believe thoroughly in the honesty of the Public Lighting Commissioners of the city of Detroit, but we think it is the individual honesty of these gentlemen and not any virtue in public ownership which to-day protects the Public Lighting system of their city from corruption and utter demoralization.

The Beauty of Niagara and its Power.

The Commissioners of Queen Victoria Park, on the Canadian side of Niagara Falls, are rather exercised over the criticisms leveled at them in connection with the power development now going on near the Horseshoe Falls. In their seventeenth annual report, they say: "The production of electrical power as a means of providing revenue has perhaps more than anything else been characterized as vandalistic in its ultimate effects on scenic conditions in the park. It should be borne in mind that at the time the park was established the science of producing electrical energy for motive purposes was practically in its infancy, the first electrical street railway in America having been put in operation in 1887. It was only when the practicability of transmitting electrical power assumed shape that the matter was considered by the commissioners as a possible means of revenue. The commissioners do not claim that they acquired the portion of the park lying south of Cedar Island looking to the utilization of this portion of the property as being eminently suited for the purpose. They do claim, however, that their recommendation to the Government which brought about the acquirement of this additional property has resulted in the greatest pecuniary advantage. Had the property not been expropriated when the park was founded—viewing it now in the light of what has transpired on both sides of the river—that part of the property would doubtless have been acquired by capitalists and laid out as a manufacturing district without reference to its scenic environments, as has been done on the American side of the river north of the steel arch bridge, to the irreparable disfigurement of the river bank. On the other hand, had it been expropriated after its capabilities as a center for production of electrical power on a large scale were demonstrated, it is quite probable that the price of such expropriation instead of the original cost of $100,000 would have been many millions of dollars, determinable only by the capitalization of the revenue obtainable from possible electrical franchises.

"Coming now to the charge that the commissioners have, in granting certain power privileges, committed acts of vandalism that will ultimately ruin the scenery of Niagara Falls, the commissioners have to state that with the exception of the Ontario Power Company's power house in the gorge under the falls, hereafter referred to, all the proposed works connected with the generation of electricity are practically beyond the territory originally designed for park purposes. When the electrical power works are completed not a single view of the falls, rapids or gorge under the falls will be obstructed in the slightest degree. On the contrary, the filling in of the shore line above the falls by excavated material from the tunnels will increase the park area very considerably and will permit of roads and walks being constructed on the margin of the river which will greatly improve the views of the upper rapids, and at the same time cover the foreshore, which in some places has become exposed by the recession of the waters, owing to the breaking away of the cataract. The waters forming the Dufferin Islands will be completely restored and improved by the construction of cascades and miniature falls, and, besides, the area at that congested point in the park will be considerably enlarged.

"Respecting the construction of the Ontario Power Company's power house in the gorge under the falls the commissioners of the State reservation made representatiions to the board in July last and were granted a hearing with particular reference to the erection of the structure at that location, the contention of the commissioners of the State reservation being that the building would not only disfigure the landscape as viewed from several points in the American reservation, but would also be objectionable from an æsthetic standpoint and at variance with the natural conditions desired by the commissioners on both sides of the rivers.

"On the other hand, it was shown by the Canadian commissioners that the location of the building in question would present no obstruction to the free views of the falls or river from any point on the American side, and as the building would be far below the surface level of the park a part of the roof and the two gable ends would be the only parts of the structure seen from any point of view within Queen Victoria Park. It was further pointed out that to make the building in any sense a conspicuous or objectionable feature of the landscape would depend solely upon the design and character given to it.

"The commissioners have also arranged for the early removal of the large and unsightly building which is so conspicuous from the American side, and which was originally constructed for a museum, but which has recently been used for a restaurant and shelter building. The removal of this structure, which has formed quite a striking feature of the park, and the substituting of a modern refectory near the center of the picnic grounds, will remove from the park one of its most objectionable features, and will more than counterbalance any temporary disfigurement which the construction of the power house may cause.

"All of the works and structures connected with the electrical power projects have been designed with the object not only of doing the least possible injury to scenic conditions, but the commissioners are confident in the belief that when the several works are completed the consensus of opinion by the vastly increased numbers of visitors who are expected to visit the park will abundantly sustain them in their contention that the park, as a whole, with its wealth of electrical machinery, will then be of tenfold greater interest to the great majority visiting it. In addition, not only will the immediate locality beyond the park be built up into one of the great manufacturing centers of the world, but the quickening impulse and vivifying effects of the whole of the world's latest and most perfect form of energy—created and sent forth by the Falls of Niagara—will be felt from end to end of the province."

Municipal Lighting at Cleveland, O.

Mr. Samuel Scovil, vice-president of the Cleveland Illuminating & Lighting Company, and Superintendent Bemis, of the waterworks department, appeared before the board and respectively presented arguments against and in favor of the erection of a municipal lighting plant in Cleveland. Superintendent Bemis said that he placed a great deal of dependence on the report of Charles E. Phelps, an electrical expert of Baltimore, whom Mayor Johnson had employed to investigate the feasibility of establishing a municipal lighting system in Cleveland. Mr. Bemis further contended that Cleveland had three advantages in connection with the establishment and operation of a lighting system which a private company would not have, namely the necessary land on which the buildings can be erected, water at practically no cost, and an opportunity of combining the waterworks and proposed lighting departments, so that both departments would be under the general supervision of one man. He stated that cities now operating their own electric lighting systems were successful. He stated further that Hamilton, Ohio, has a municipal lighting system which furnishes electricity to private consumers in opposition to a private lighting company.

During the discussion Superintendent Bemis proposed to Mr. Scovil that the city would be willing to purchase the West Side equipment of the Illuminating Company, in order to save installing an entirely new equipment. Mr. Scovil ignored the proposition.

In arguing against the proposed plant, Mr. Scovil said:

"The proposition to install an electric lighting plant as now suggested in Cleveland, is a most unusual proposition.

"The statement is made that the plant is to be equipped not alone for the purpose of lighting the streets and the city municipal buildings, as is the case with other municipal plants in this country, but to go into the business of commercially selling light and power to users generally. In short, under the conditions existing now in Cleveland, it is a proposition to use the taxpayers' money to compete with private capital engaged in the same business. This is a novel departure in municipal ownership undertakings.

"Mention was made here last Friday of the waterworks department being operated successfully by the city. The conditions in relation to the supply of water and electricity are very, very different. Water is a necessity in every home. If the service is once introduced in any building, that building continues to be a source of revenue to the waterworks. It is not so with electricity. Here, the city plant will not have a complete monopoly, so the business will have to be handled on different lines. Aside from the important fact that the field is already occupied by a well-equipped company, electricity is not a necessity either as an illuminant or for power purposes. People can, and do, use other agencies freely for these purposes.

"The engineer's estimate submitted to the Council indicated that an arc lamp for street lighting would cost the city about $53.67 per annum. As compared with this estimate, the following figures in relation to the costs of arc lamps, as furnished by municipal plants operated by other cities, is of interest.

"Chicago has a municipal plant which has been in operation since 1888. The cost to the city per arc lamp per annum from 1888 to 1900, inclusive, shows an average of $142.18. These are not my figures. They are the figures as reported to the city of Chicago by Messrs. Haskins & Sells, public accountants, employed by the city of Chicago itself to investigate and revise its accounting system. The cost of a city lamp in the Chicago plant for 1901, as given by the city electrician, plus interest, depreciation, etc., is $95.27.

"The city of Allegheny reports a total cost per lamp per annum of $72.98. In arriving at this figure they figure depreciation at only 5 per cent.

"The Detroit municipal plant, operating some 2,200 street lamps, reports its cost as being $63.82 per lamp per annum. In arriving at this price they only figure depreciation at 3 per cent. In reality, the average cost to the taxpayer, as per appropriation each year for which taxes have been levied and collected for the plant, has been $85.08 per lamp per annum.

"The city of Cleveland is paying the present company $75 per lamp per annum, and this price is made on a one-year contract. In figuring depreciation at only 3 per cent., as the city of Detroit does for its plant, it is assuming that the apparatus in the plant will have a life of thirty-three years, which is altogether out of reason. Were the illuminating company given an opportunity to figure on a term contract, whereby it could distribute its depreciation over a considerable period of time, it could necessarily make a lower price for the lamps which it would furnish."

New Telephone Patents.

AN IMPROVED TRANSPOSITION.

Under the title, "Telephone Circuit," Mr. F. W. Sorg has obtained a patent for an improved transposition for line wires. For many years there have been but two general types of transposition, the so-called "English" method wherein the continuity of the wires is maintained through the transposition joint and the American standard, by which the wires are cut, spliced and reversed. In the former method each line wire makes a quarter turn about an insulator on one pin, then crosses over and makes a reverse quarter turn about the corresponding insulator of the other pin. With such a method longitudinal strains at the insulators are balanced, but there is left a force tending to pull the two pins toward each other, equal to the sum of the tensions in the line wires.

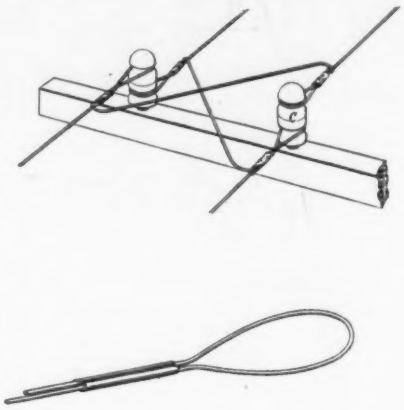


FIG. 1.—SORG LINE TRANSPORTATION.

With the American method all four approaching wires are dead-ended each about one section of the insulator of one of the pins. The projecting ends of the dead-ends are then crossed over and spliced. By this method the two wires may be run straight from end to end, and no abnormal strains occur at the pins except those due to the difference of height upon the pin of the tie grooves of the two sections of insulator. Mr. Sorg's invention consists of a dead-end similar to the American practice and a cross-over similar to the English. This will be appreciated from Fig. 1. The dead end is accomplished by means of a split sleeve, a loop being first formed in the wire, a sleeve put in place and the twisting accomplished by clamping the line end and twisting the loop end. The loop is then slipped over the insulator and held by tension. While the splicing of the line is avoided, it seems rather probable that the expense of reversing the line at each transposition will nearly offset this saving.

STEP-UP CENTRAL ENERGY REPEATING COIL.

In Fig. 2 is shown a new method of repeating in central energy systems at the point of division in through circuits made necessary by the application of the battery. Heretofore the ratio of conversion at the repeating coils has been one to one, so that equally good transmission is obtainable in both directions when similar types of telephone instruments are at both ends of the line. This ratio has

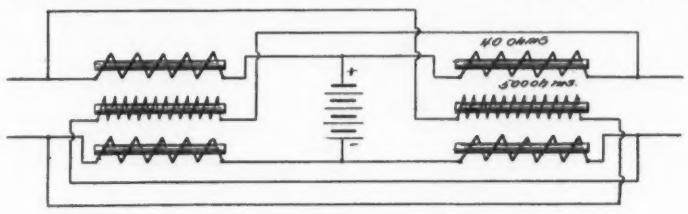


FIG. 2.—CURRIER REPEATING COIL.

limited the resistance of receivers to a comparatively low value and one not always giving the best efficiency. With the step-up repeating coil system, one repeating coil is used toward each end of the line. These have low resistance primaries, through which the current is fed to the transmitters and high-resistance secondaries of many turns. The secondary of one coil is connected to that line section associated with the primary of the other coil, as shown. Thus fluctuations set up in one section of the line by its transmitter, affect the corresponding coil and through the secondary generate higher voltage fluctuations upon the second section of the line where they pass to the receiver. Mr. Hiram D. Currier, of Ottawa, Ohio, is the inventor of this system.

Electrical Engineering Instruction at Columbia University.

By George F. Sever.

THE education of a young man for the electrical engineering profession is the problem which confronts many men in the various technical schools, colleges and universities throughout this country. Owing to the rapid development of all lines of electrical industry, the educator in electrical engineering had to overcome many difficulties in designing a course of instruction which meets the rapidly changing and developing conditions. Probably in no other branch of engineering has such an enormous development taken place in so short a time. All other engineering professions, civil, mining and mechanical, have been developed through long periods of time, and the subjects to be taught are definite and the ideas involved have been illustrated in many text-books suitable for instruction.

In the earlier days of electrical instruction there were only the electrical units, the telegraph, telephone and the beginnings of electric lighting. Those subjects as well as the underlying principles were taught under the department of physics in the various schools and universities.

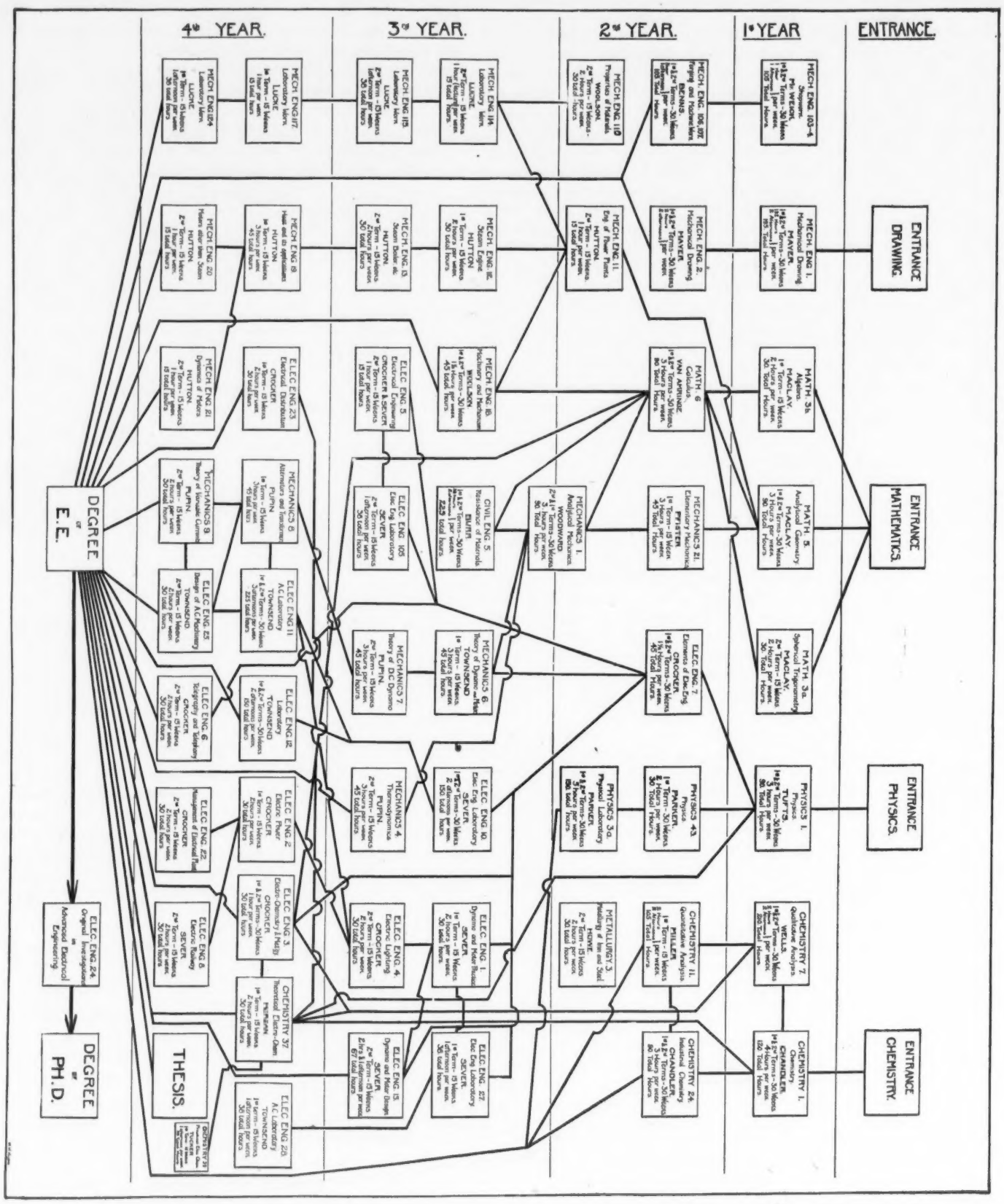


CHART OF ELECTRICAL ENGINEERING COURSE, COLUMBIA UNIVERSITY, NEW YORK.

In 1889 there was established at Columbia College the Department of Electrical Engineering. It was under the guidance of Profs. F. B. Crocker and M. I. Pupin and was one of the earliest established in this country. Its instruction was distinguished from that given elsewhere by the fact that the Department of Physics confined

its work to that subject specifically, while all the applications of electricity were taught in the Electrical Engineering Department. Furthermore, those who completed this engineering course successfully, received the degree of "Electrical Engineer," while in most other institutions "Mechanical Engineer" or "Bachelor of Science" is the degree conferred. Since that time other universities and technical schools have followed the example of Columbia in completely separating their electrical engineering course from that of physics, or mechanical engineering. As a result of the independence of this electrical engineering course, the department has had the services of the associate departments at its command for the instruction of the electrical students, but it has not been hampered by the necessity of carrying out instruction in physics for the students in all courses which otherwise would greatly interfere with the work of the department in relation to its own students.

Since 1889 the electrical department has grown, both in personnel, numbers of students and in equipment. In moving from the old site on Forty-ninth Street much more commodious quarters were provided in the new Engineering Building, and an opportunity was provided for bettering the laboratory equipment, as well as the arrangement of the studies. In arranging the curriculum, the attempt is not made to turn out men fitted only for some special line of work, that is, those who are informed solely as to one line of electrical engineering work, but to so equip every man that when he finishes his course he has the fundamental facts relating to his profession clearly and absolutely fixed, is able to think clearly and logically, and has had developed by laboratory training his investigating ability and a certain amount of independence of action. On account of the exactness of the electrical engineering profession, it is possible by proper care and forethought to train the man's mind so that he is excellently equipped in the logical sequence of thought and can respect the certainty of his results. These conditions are not present to the same extent in any other line of engineering work.

The chart which accompanies this article is intended to show the technical entrance requirements, the course of study during the four years which the student spends in the department, the weight given to various lines of study and the use of earlier studies in carrying forward work in the higher courses. The heavy lines connecting the various subjects indicate the sequence in which the subjects have to be pursued and also the subjects which have to be taken, as might be said, in parallel. The failure in any subject prevents the securing of the electrical engineering degree.

This method of presentation of a prescribed technical course has been found of great value, both to students and instructors. Ordinarily the student cannot clearly see what is coming and does not understand the relationship of his various courses. This graphical representation avoids, to a great extent, his lack of appreciation of what is to be met with in the future.

The importance of studies such as English, elementary history and foreign languages is not brought out by the studies recorded in this chart. For entrance, the candidate must pass all of the following studies, which have different values, as shown:

Mathematics, elementary and advanced,	counting	4 points.
Physics	"	1 point.
Chemistry	"	1 point.
Drawing	"	1 point.
English	"	3 points.
Elementary history	"	1 point.
Elementary German	"	2 points.

and two points from one of the following subjects:

Elementary French	counting	2 points.
Spanish	"	2 points.
Elementary Latin	"	2 points.

It will be noticed that English, elementary history and two other languages count for 8 points out of 15, or about 53 per cent. of the total entrance requirements.

The engineering student has his time so filled with necessary scientific and technical subjects that it is not always possible to introduce such culture studies as history and literature, which are extremely important for him to possess, consequently, the trustees and engineering faculty have recommended the candidates to take advantage of the opportunities offered in Columbia College, the Academic Department of the University, before entering the professional courses.

Under this curriculum students, at the end of four years, may obtain the degree of "Bachelor of Arts," and may at the same time prepare themselves to enter the third year of any of these professional schools, and take their technical degrees two years later. As students may and do enter the college two years earlier than they enter the professional schools, they will be able by taking this combined course of study to obtain the professional degree at the same age as though they entered the professional school in the first instance at the present average age. This combined six-year course is strongly recommended, for the reason that engineers and chemists, as professional men, need the liberal training offered by a collegiate course quite as much as do lawyers, physicians or clergymen. Experience has shown that those who have pursued a liberal course of study, and who have enjoyed the advantages of such an education before beginning their technical studies, have usually attained a higher standing in their profession and have exercised greater influence in the community than those who have relied upon a purely scientific or professional course of study.

The degrees of "Master of Arts" and "Doctor of Philosophy" are awarded by the University Council upon the recommendation of the Faculty of Applied Science for advanced work in electrical engineering. Candidates for either of these degrees must hold a baccalaureate degree in arts, letters, philosophy or science, or an engineering degree, or an equivalent of one of these from a foreign institution of learning.

Candidates for the degrees of "Master of Arts" and "Doctor of Philosophy" must pursue their studies in residence for a minimum period of one and two years respectively. In most cases three years of study are usually necessary to obtain the degree of "Doctor of Philosophy." The year spent in study for the degree of "Master of Arts" is credited on account of the requirement for the degree of "Doctor of Philosophy." Residence at other universities may be credited to a candidate. In certain cases and by special arrangement, time exclusively devoted to investigation in the field will be credited in partial fulfilment of the time required. No degree will be conferred upon any student who has not been in residence at Columbia University for at least one year.

In the electrical engineering course a large amount of instruction is given in mechanical engineering subjects, including practice in the mechanical laboratories, testing steam and other mechanical appliances. Under the Department of Chemistry during the first two years, fundamental qualitative and quantitative courses are given, with a large amount of laboratory work, and in the fourth year are given courses in electrochemistry so arranged that the theoretical instruction and the laboratory work parallel each other. Particular attention is devoted in the Department of Physics to the electrical students, and this work is supplemented in the Electrical Engineering Department by a thorough course in the careful calibration of instruments and the study of advanced electrical measurements. The Civil Engineering Department provides a course in the resistance of materials involving instruction in the design of girders, columns and general structural work, which is particularly valuable for electrical engineers. A broadening course given in the second year under the Department of Metallurgy provides the student with an understanding of the manufacture of iron, steel and copper, which are the materials he will use in his subsequent work.

Probably the greatest weight is given to that tool of all engineers, mathematics. It will be noticed on the chart, starting at the subject of entrance mathematics, what important consideration is given to this work. A student failing in mathematics in his first or second year is absolutely prevented from advancing further in most of his studies until he has fulfilled the mathematical requirements. No other subject is so absolutely essential to the success of an engineer as is that of mathematics.

Laboratory work in electrical engineering is fundamentally important for the student to enable him properly to understand electrical actions. Experimental lectures and the use of diagrams are valuable, but nothing can compare with laboratory instruction in proving to a man's mind the actuality of electrical actions. In no other profession is imagination so necessary to the comprehension of the mutual relationship of forces. It is necessary for him to understand what will happen before he actually combines the physical parts. It is not always possible in a lecture to convey to the students' comprehension the various actions which will take place in electrical circuits. If, however, he can demonstrate to himself these actions by actual apparatus, he then thoroughly understands and remembers them. For the above reasons the electrical laboratories have been equipped with apparatus to demonstrate the principles, and the apparatus has been so chosen that the students may operate it without danger to themselves.

All laboratory instruction has to be modified in order to conform to the limitations of the laboratory equipment, therefore it will be found that no two laboratories have the same methods of instruction. We may all have the same ideals, but almost all differences of opinion relating to engineering education will be found to be based upon the variations in personnel and equipment.

Magnetic Increase of Traction.

The increase and decrease of motor traction is a subject which has been considerably discussed by engineers, and as is well known, a number of devices have been invented not only to lessen the tractive

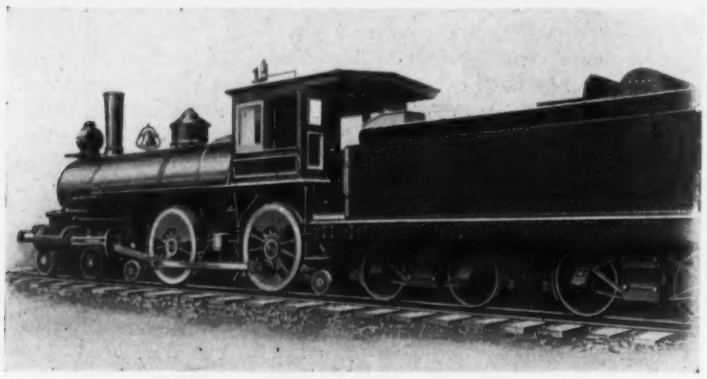


FIG. 1.—MAGNETIC TRACTION ON LOCOMOTIVES.

power, but to increase it when such a condition is desirable. So far, however, the sand box is one of the requisites in connection with the ordinary steam locomotive and the use of sand upon city and suburban electric railroads is also very extensive. Apparently this method is best adapted to keep the drivers of the locomotive and the wheels of the trolley car from slipping upon wet rails or in moving up a heavy grade.

In a comparatively recent invention, however, electromagnetism has again been tried as a substitute for sand. A simple magnet is used connected with what is termed an idler wheel. The operation of the system is as follows: When applied to an ordinary trolley car, on each side of the motor, between the motor casing and the wheel, is a bearing which supports an arm upon which the magnetizing coil of wire is wound. The other end of the arm carries a small wheel without any flange, which rolls along the rail when the device is in operation, and is held above the rail by springs when the coil is not energized. The object of this arrangement of an "idler" wheel upon the rail is to give a short magnetic circuit. The lines of force in this case flow from the arm to the car journal and wheel, from the wheel to the rail, from the rail to the idler wheel and thence to the coil-wound arm.

The experiments have been conducted with this method of increas-

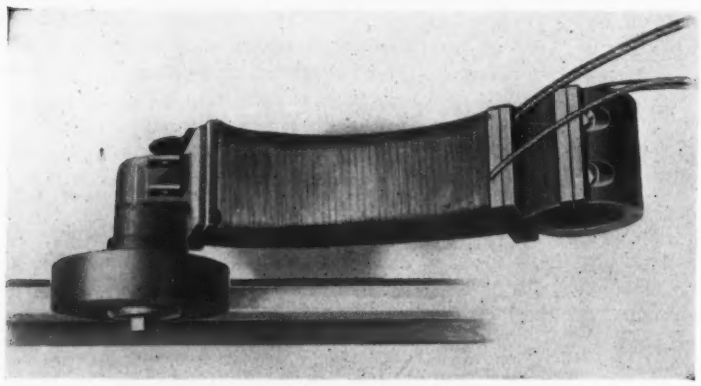


FIG. 2.—MAGNET AND IDLER WHEEL.

ing traction on both street and steam railroads. In Seattle, Wash., a double-truck car was equipped with two 50-hp electric motors for driving purposes, also for supplying what might be called the traction current. The idler wheels were held at a distance of five-eighths of an inch above the rail when the magnet was not energized. The current was controlled by a switch operated by a lever at the motorman's elbow, so that it could be turned on and off as readily as the motor current. It was found that with an expenditure of 2½ hp the magnetism developed increased the tractive effort over 300 per cent. In one instance the wheels and rails were greased and the car started. When the wheels began to slip, the draw-bar pull was found to be 1,500 pounds. When the magnets were energized this was increased to 5,250 pounds. In another test the model of a trolley car by use of the device was moved up a track constructed

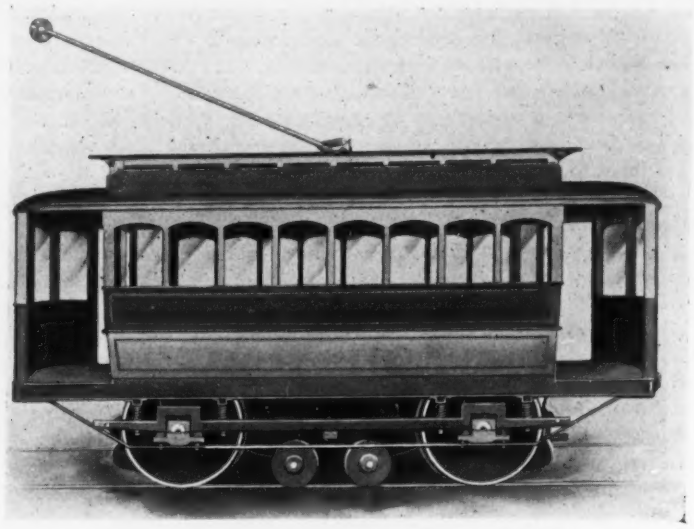


FIG. 3.—MAGNETIC TRACTION ON TROLLEY CAR.

at an incline of 45°. When the current was turned off the magnet, however, the ascent was found to be impossible.

The claim made for the apparatus is that its application to a steam locomotive would not necessitate the use of such heavy locomotives as are at present built for service on heavy grades since the electromagnet would act as a substitute for much of the weight now required to secure the necessary traction, while as already stated, the invention is intended to do away with the use of sand entirely. The inventor of the device is A. A. Honey, an electrician of Chicago, who was formerly superintendent of telegraphs of the Northern Pacific Railway Company. Two patents on the subject were issued to him on June 16.

Multiphase Arc Lamp.

Mr. Richard Fleming, well known as an inventor and engineer in the arc lighting field, has recently patented some work on multiphase

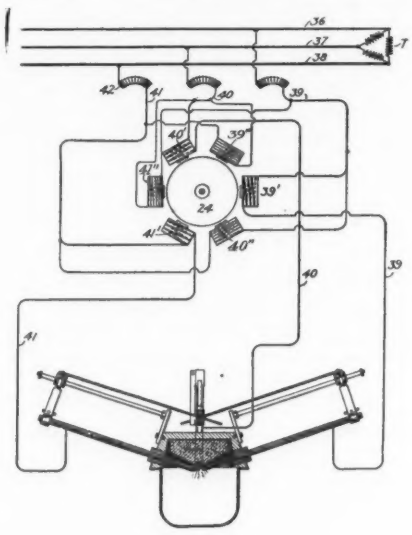


DIAGRAM OF LAMP AND GENERATOR CONNECTIONS.

arc lamps. In one patent the central idea is the provision of a common feed mechanism of solenoid coils, for all the electrodes, influenced by the current passing in all branches of the multiphase system. In a later patent, the principle exemplified is that of feeding all the electrodes through the intervention of an induction motor. The operation of the lamp is as follows: Assuming the electrodes to be separated, on closing the switches in the lines 39, 40 and 41, re-

spectively, current will begin to flow through the windings 39″, 40″ and 41″. This sets up a rotary magnetic field, which turns the armature 24 in the direction suitable to feed the electrodes toward their point of convergence. When the electrodes contact with one another, current begins to flow through the electrodes. This energizes the polar extensions surrounded by the windings 39′, 40′ and 41′. These are connected, as shown, so as to produce a magnetic field rotating in opposite direction from that produced by the windings 39″, 40″ and 41″, and these fields are proportioned so that on the passage of an excess of current through the electrodes, as at starting, the field produced by the windings 39′, 40′ and 41′ overcomes that produced by the other windings and rotates the armature in such a direction as to separate the electrodes. When the electrodes have been separated the desired amount, the increased resistance of the arc due to such separation diminishes the current flowing through the windings 39′, 40′ and 41′, so that the fields produced by the two sets of windings balance one another and the armature remains at rest. An increase of resistance in the arc, causing a further diminishing of the current in the series windings, will have the effect of causing the armature to turn in the feeding direction under the influence of the shunt-windings, while an increase of current passing through the series windings will cause the electrodes to be separated. By this arrangement, it is said, a very sensitive and efficient feeding mechanism is obtained.

Data on Siloxicon.

By E. G. Acheson.

The descriptions of the new refractory substance, siloxicon, that have recently appeared in the newspapers have created a widespread interest, but one or two points need clearing up in regard to it. It was stated that siloxicon was inoxidizable, but recent investigations have shown that this is not true. When it is heated to, or above, 2674° F. in an atmosphere containing a large amount of free oxygen decomposition occurs.

Siloxicon, while variable in composition, may be represented by the formula Si_2C_2O, and when heated, as above stated, in presence of free oxygen, decomposition takes place, probably in accordance with the following equation:

$$Si_2C_2O + 7O = 2SiO_2 + 2CO_2.$$

If the siloxicon be in the form of a brick or other molded mass, the reaction occurs on the surface, producing a vitreous glaze, which in most instances is tinged light green from the presence of iron.

In the absence of free oxygen or in a reducing atmosphere, no such decomposition occurs, and the temperature may be raised to the point of the formation of carborundum, or, approximately, 5000° F., before any change occurs, and then it takes place, it is thought, in accordance with this equation:

$$Si_2C_2O = SiC + Si + CO,$$

solid carborundum remaining, while the vapor of silicon and carbon monoxide are given off.

It is interesting to note that after having discovered this oxidation of siloxicon, tests were made with carborundum, and it was found to be affected in a manner exactly similar to siloxicon; this notwithstanding the fact that for more than twelve years it had been generally considered inoxidizable.

CURRENT NEWS AND NOTES.

ITALY AT ST. LOUIS.—It is stated by advices from Rome that Italy will occupy just about 60,000 square feet at the St. Louis Exposition, including 4,875 for mining and electricity, and 13,000 for varied industries.

STRIKE LOSSES.—As a result of the long deadlock in the building trades, in New York City, 2,000 electrical workers are out $256,000 in wages they would have received. This is but one item of the needless loss and trouble.

WIRELESS TELEGRAPHY IN CHINA.—A despatch to the London *Times* from its Pekin, China, correspondent states that the Italian legation in that city is installing a Marconi wireless telegraph station for the purpose of communicating directly with the ships in the Gulf of Pe-chi-li.

NORTH SEA TELEPHONY.—Telephonic communication has been established between England and Belgium, the service being operated by the telegraphic departments of both countries. The price is 10f. for three minutes. On the French service between Tours and Paris two separate conversations can be carried on simultaneously on the same line by the method invented by M. Petit, inspector of the electric service at Tours.

MEDICAL ELECTRICITY.—Dr. D'Arsonval, lecturing in Paris last week on the effects of electricity upon human beings, expressed the belief that the world is on the eve of a therapeutical revolution, electricity being the medicine of the future. He demonstrated the utility of electrical treatment in skin diseases and said that under anæsthesia produced by electricity, a patient could be subjected to slight surgical operations without narcotics.

THE PACIFIC CABLE.—Advices of June 20 from San Francisco state that within a week the last link of the Commercial Pacific cable will be laid between San Francisco and Manila, and the United States will have direct communication with its Philippine possessions. The cable ship *Colonia* reached Midway Island on June 19, completing the link between Guam and Midway, and immediately on its arrival the *Anglia* departed for Honolulu to close the last gap in the transpacific cable, a distance of 1,160 miles.

TRAFFIC REGULATION IN LEIPZIG.—United States Consul B. H. Warner sends the following from Leipzig, May 26, 1903: "Municipal ordinances prescribe that electric street cars shall not run at a higher rate of speed than 9 miles an hour in the business sections; with trailers, 7.2 miles; in residential sections, 10.8 miles an hour, or 9 miles with trailers; and in the suburbs, 15 miles, or 12 miles with trailers. The penalty for exceeding the speed limit is a fine up to $15 or imprisonment for fourteen days, or both. In case of accident, a higher penalty may be inflicted. The city council, at a recent meeting, passed an ordinance prohibiting the use of automobiles in most of the streets of the inner city, and in other parts allowing them to be driven only along those streets which are traversed by electric cars."

WHAT COLD DOES.—In the July *Booklovers' Magazine*, Mr. G. W. Warder says: "Heat can exist only where there is an atmosphere, and then it must be constantly supplied with fuel to overcome the law of constant repulsion and diffusion. Cold is the absence of heat and exists everywhere. It overcomes disintegration and preserves the universe. It enforces the universal law of the electric attraction and cohesion of atoms and worlds. Cold must predominate to preserve the universe. There is a billion times a billion more cold in the universe than heat. There always has been and there always will be. The heat of the sun, compared with the cold that surrounds it, is as a mustard seed to Jupiter. The earth's heat, in comparison to the cold that surrounds it, is as an orange to the solar system. Then what folly to talk of the universe having begun in white heat, and the earth having been a molten world, and the suns great burning spheres."

PROTECTING WESTERN UNION WIRES.—At Wilmington, Del., on June 19, in the United States Circuit Court, Judge Bradford heard the arguments in the case of the Western Union Telegraph Company versus the Philadelphia, Baltimore & Washington Railroad, the Delaware Railroad and the Delaware, Maryland & Virginia Railroad, in an action to restrain the railroad companies from removing the poles and wires of the telegraph company from their rights of way. Counsel for the telegraph company contended that the conditions affecting the case were different in Delaware than in other States, and asked a ruling of the court. Counsel for the railroad companies held that conditions in all the States were similar, and said it would be unnecessary to proceed with the argument now as the decision of the suit instituted in New Jersey was now pending in the Supreme Court of the United States, and that it would determine the issue in all other cases. Judge Bradford reserved decision. The United States Supreme Court has, according to a Baltimore dispatch of June 20, granted an injunction restraining the Pennsylvania Railroad from interfering with any of the lines of the telegraph company. This action, it is stated, will keep the telegraph property in *statu quo* until the final decision is reached on the main case at the next term of the Supreme Court of the United States.

LONDON UNDERGROUND ACCIDENT.—According to a special cable dispatch from London of June 17 there was another collision on the London Underground Railway that day in which the last two cars of the forward train were wrecked. Six passengers were seriously hurt and fifteen slightly injured. The accident occurring just before this was attributed to the electric "tube" road, which has, however, been remarkably free from such casualties.

PRACTICAL HIGH-TENSION WORK.—In his paper before the Canadian Electrical Association, Mr. Paul M. Lincoln said: "Put to the fresh college graduate the problem of the amount of distance to be left between the conductors of a high-tension transmission line. His answer will involve most likely the jumping distance of the voltage to be used, the length of span, the sag and perhaps a liberal factor of safety. It is experience only that will show that his premises are wrong and that the equation to determine spacing of high-tension wires depends very little on the voltages to be carried and almost entirely on such things as the average length and ohmic resistance of cats, the spread of wing of owls and cranes and eagles, and the average length of scrap baling wire, together with the strength of the average small boy's throwing arm."

LARGE CURRENT PLUG FUSE.—Mr. Herbert C. Wirt, of the engineering staff of the General Electric Company, has taken out a patent on plug fuses for large current circuits. The idea is to provide a plug fuse which shall be compact, easily and economically constructed, and which at the same time may be readily taken apart for the purpose of renewing the fuse and when in use shall be substantially proof against disruption by the gases generated within the same upon the burning out or blowing of the fuse link. The invention consists of a metallic shell closed at one end by a cap, which may be either removably or permanently connected thereto and the other end adapted to receive and hold securely therein a piece of insulating material provided at its center with an aperture, whereby the fuse or a part making contact with the fuse may be centered and held out of electrical contact with the sides of the metallic shell. The exterior of the metallic shell is adapted for insertion into a receptable and the current closed through the shell, its cap and the fuse to the center contact of the receptable. The fuse link shown consists of a strip associated with crimped or accordion-plaited fibre insulation which it is threaded through and which keeps it from coming in contact with the inner wall of the base casing when weakened by excessive current.

MOTOR BRAKING DEVICE.—Mr. G. O. Baker has been granted a patent on his method whereby an electric motor used for driving machinery may be converted immediately into a braking generator by the operation of a circuit-breaking device controlling the power circuit. In many classes of machines—such, for instance, as printing presses—it is desirable to be able to stop the machine very quickly to prevent injury to the mechanism or the work. When the machine is driven by an electric motor, it is well known that the supply of current to the motor may be quickly cut off by including an electromagnetic circuit-breaker in series with the motor and providing a control circuit, with push buttons located at convenient points, so that an attendant by pressing one of said buttons can cause the circuit-breaker to operate. It has also been proposed to so construct a motor controller that when necessary it will automatically shut off the power by coming to "off" position and will then short-circuit the motor through a resistance, so that the motor will act as a generator, driven by its own momentum, and that of the machine to which it is connected, and thus serve as a brake to stop the machine. Mr. Baker's invention aims to combine both these ideas by so constructing the circuit-breaker that when it operates it will automatically close the circuit of the motor through a local circuit, thereby causing the motor to act as a braking generator immediately without waiting for the controller to be returned to its off position or for the operation of any intermediate mechanism.

RESISTANCE SETS.—Mr. Edwin F. Northrup, of Philadelphia, has secured a patent on improvements in resistance sets. The principal objects of his invention are to effect an arrangement of resistances whereby a comparatively large number of resistance values may be gotten from a small number of resistances, and also to effect an arrangement of connections whereby these values may be obtained in regularly-increasing order by introducing the resistances between two contacts or brushes through which current passes to and from said resistances, and between which brushes and resistances there is relative movement. A further object of this invention is to effect an arrangement of resistances whereby one may expeditiously obtain a series of ratios of resistance—such, for example, as are required in making a variety of tests with a Wheatstone bridge. It has generally been customary heretofore in varying electrical resistance in a circuit to connect the terminals of the circuit to the resistances and to alter the resistance by cutting in or out of the circuit varying amounts of resistance by means of plugs, brushes or other contact-makers, which form no part of the terminal connections or only one of the terminals. In the common form of rheostat the brush is usually connected to one of the terminals, while the other terminal is permanently secured to the resistance coils. In contradistinction to all such methods the Northrup invention contemplates varying the resistance by inserting varying amounts of resistance between two brushes or other contacts, which are direct-connected to the terminals of the electric circuit. The resistances are in this case of such values as may be combined to give regularly-increasing value of resistance greater in number than the resistances employed. These combinations of resistance are predetermined, and the said resistances are connected up in accordance with such combinations to a series of contact plates. The resistance is then varied by bringing successive combinations of the contact plates into engagement with the brushes. Mr. Northrup states that he has discovered that by giving the resistances certain values and by connecting them in certain prearranged combinations he can by means of the arrangement of connections above referred to get ten regularly-increasing values of resistance with only four resistances. The same general principle appears susceptible of even wider practical range, as noted in another patent of the same date.

DIAMAGNETIC SEPARATION.—No fewer than 11 patents were granted to Mr. Elmer Gates, of Washington, D. C., on June 16 for various modifications of his method of diamagnetic separation and for apparatus used thereby. The purpose is to separate free particles of diamagnetic metal, such as gold, copper or the like, from other material. The separation is effected by dropping the mixture in powdered form through a long narrow air-gap between the poles of a strong electromagnet, this air-gap being either vertical or slightly inclined. While under the action of the strong magnetic field, the particles of greater diamagnetic susceptibility move away from the other particles into a relatively weak part of the field and are then separately collected. If the material is fed into the magnetic field so as to drop immediately adjacent to the pole-faces, the diamagnetic particles of greater susceptibility move toward the center of the interpolar space and are collected by a hopper located immediately below the center of this space. Several devices may be used to keep the particles as long as possible under the action of the magnetic field. This may be due, for instance, by passing the particles through a retarding fluid which is moved upward in opposition to the descent of the material. Or the number of lines of force, traversed by the particles, may be increased by rapidly moving the magnetic field in a direction opposed to the feeding of the material. For this purpose he places a number of revolving electromagnetic devices one above the other; or he uses stationary electromagnets placed one above the other, their coils being connected to a rapidly revolving circuit-breaker of such a nature that a succession of correspondingly rapid energizations of the magnets will take place, succeeding each other from one end of the series to the other. In one of the patents Mr. Gates proposes the following method of separation of free particles of diamagnetic metal, such as gold, copper or the like, from other material with which it is associated, as, for instance, in sea sands, placer sands and alluvial deposits generally. He first mixes with the sand about 5 to 10 per cent. of finely divided iron, nickel or other magnetic material of relatively high specific gravity; the mixture is stirred in the presence of water, and permitted to settle. The particles of gold or other diamagnetic metal, together with the particles of iron, etc., sink to the bottom; in the layers at the bottom the diamagnetic metallic particles are so entangled with the magnetic particles that they may be separated from the main residue of diamagnetic sand by means of ordinary magnetic separators. The result of this initial operation is a mixture of magnetic material and diamagnetic metallic particles, which are then separated by being subjected to the action of another separator particularly adapted for that purpose.

YACHT RACE AND WIRELESS TELEGRAPHY.—Arrangements have been made by the Associated Press with the Marconi Wireless Telegraph Company of America to employ that system of wireless telegraphy in reporting the international yacht races soon to occur. It has been reported that another system would be used by the Associated Press, but General Manager Melville E. Stone authorizes the following statement on behalf of the Associated Press: "We have arranged with the American Marconi Company to serve us with wireless news during the international yacht races."

CUPID'S CARS.—The New York & Stamford Railroad Company, which operates a trolley line in Larchmont, Rye and other towns on Long Island Sound, has discovered that its motormen and conductors devote too much time to their young women friends, and has posted an order, which reads: "The last three seats and rear platform are reserved for smokers. To be more specific, do not reserve it for your 'lady friend.' Let her be seated with the rest of the crowd. It may have a tendency to decrease the number of complaints received at the office lately. The conductor's place is on the rear platform, unless he is collecting fares, issuing transfers or assisting passengers on or off the car." The company, it is said, employs good-looking men and many young women have been in the habit of riding on the platforms and in the rear seats to talk with them.

LIGHTING IN NEW YORK.—The Aldermen's Committee on Water Supply, Gas and Electricity, in New York City, gave a public hearing last week on the application of the Long Acre Electric Light & Power Company, for a franchise to lay wires and operate an electric lighting plant on the territory bounded by Thirty-third and Fifty-ninth Streets, Fifth Avenue and the North River. The company has been promoted by the principal theatre managers to supply their theatres. Maurice Goodman, who appeared for the people behind the company, stated that his clients were getting tired of paying high prices and would be willing to supply the city with light at half present prices. The Consolidated Telegraph & Electric Subway Company objected that it had the exclusive right to lay conduits for wires. Mr. Goodman said his company would be willing to use the conduits of the subway company. The committee will hold another hearing.

EVERETT-MOORE TELEPHONE PROPERTIES.—It is said that the Everett-Moore syndicate of Cleveland, after taking just a year and a half, has straightened out its tangled affairs resulting from overexpansion in the electric railway and telephone field, and every company which was involved in the Everett-Moore failure now stands squarely on its feet. In a recent interview, Mr. E. W. Moore said: "Our telephone companies are now on a self-sustaining basis, and are showing a handsome surplus above fixed charges. There is great development in the West among the independent telephone companies. Almost every town of any size has an independent telephone exchange, and these exchanges are being connected up by the larger independent companies. Our Cleveland company will soon be connected with Pittsburg and will also be doing business in Buffalo, Western Pennsylvania and New York. It is now doing business throughout Indiana, and Michigan, and in time will extend to St. Louis, Baltimore and Philadelphia."

LIGHTNING ARRESTER.—A patent was granted on June 9 to Dr. Louis Bell for a lightning arrester which serves to protect the line from minor abnormal rises of potential as well as from lightning. The device consists of an auxiliary shunt to earth from a point on a series gap arrester nearer the line than the regular ground. This shunt path contains in series a large ferric inductance and a resistance of several thousand ohms. As regards static rises of potential or resonance effects on the line, the shunt acts as a comparatively easy path to earth, being in series with merely enough spark gaps to prevent the passage of current under the potentials ordinarily likely to be present on the line. As respects heavy currents or very sudden discharges like lightning, the shunt path is a rather difficult one, and the tendency is to throw such discharges over the main path of spark gaps to earth. The arrester can, therefore, be so adjusted as to be exceedingly sensitive to small rises of potential without producing violent discharges to earth, while under severe conditions it operates in the ordinary manner. It is intended particularly for application to transmission lines where minor rises of potential are common, and there to serve the double function of line discharger and lightning arrester, thus preventing abnormal line potentials without making the arrester proper hypersensitive and likely to cause trouble from continual flashing.

GERMAN CABLE LAYING.—Mr. R. Guenther, United States Consul-General at Frankfort, Germany, in a report to the State Department, says: "A new era in German cable construction began with the laying of a cable to Vigo, Spain, a distance of about 1,300 miles. During the last seven years Germany has laid 7,375 miles of cable, at a cost of over $7,000,000. In 1898 a cable, 73 miles in length, was laid between Sassnitz and Trelleborg, and in 1899 German Southwest Africa was connected with the international telegraph system by a cable 154 miles long. In 1900 the first German-American cable between Emden and New York, via the Azores—a distance of 4,813 miles—was laid. At about the same time Germany put down the first German cables along the Chinese coast, the cable Tsintau-Chefoo being 285 miles and that connecting Tsintau and Shanghai 438 miles long. The year 1901 witnessed the laying of the fifth cable between Germany and England, connecting Borkum and Baktou, a distance of 280 miles. The telephone cable between Fehmarn and Laaland was laid in 1902. The construction of a second transatlantic cable between Emden and New York, via the Azores, has been commenced and it will, it is expected, be ready for service before the expiration of the next year. Germany is also contemplating an increase of her cable net in eastern Asia and the South Sea, by constructing cables between Alenado and Guam and the Palau Islands and Shanghai. It is said that the growth of German interests, both military and commercial, will in the future require the building of more cables by Germany, independent of foreign nations. Germany now has cable works and two cable steamers."

LETTER TO THE EDITORS.

Storage Batteries with Pottery Diaphragms.

To the Editors of Electrical World and Engineer:

SIRS:—The recent introduction of pottery diaphragm storage batteries in the market has naturally opened a discussion as to their merits, and especially the question of their internal resistance. Having had an experience of fourteen years of careful study in the working of this type of cell, the writer begs to offer some thoughts along this line.

Almost every man versed in the working of storage cells, upon first impulse, says that the introduction of pottery diaphragms between the electrodes of a storage battery increases the resistance so as to impair the efficiency. If, however, these storage battery experts would give some careful thought to the matter and try an experiment or two, they would be surprised to find themselves in error. It is not a question of bathing the active material and electrode with free electrolyte, but a question whether there is sufficient electrolyte to do the work. If the pottery diaphragms are properly made, and sufficiently open-grained to allow a free saturation, then the internal resistance is not materially increased. It is, of course, necessary to allow freedom in the escape of gases, especially at the hydrogen electrode, and the manufacturer carefully provides for this.

Then again, in the case of grid batteries of the type heretofore used, a considerable part of the electrode exposure is metallic lead, the active material exposure being in spots over its surface, while in the pottery diaphragm batteries the active material exposure is complete, as it covers the entire face of the electrode. This complete active material exposure reduces the internal resistance of the pottery diaphragm batteries and offsets any slight interference of the diaphragm itself.

Almost all of the grid manufacturers have for some time used wood diaphragms between the electrodes to prevent buckling and short-circuits by the jumping out of plugs of active material; and at least one company is using pottery diaphragms in the same way. The trouble with wooden diaphragms is that the acid of the electrolyte gradually carbonizes the fibre of the wood, and then a leakage of current ensues, and the woods have to be removed and new ones inserted. The merits of the pottery diaphragm battery are many.

It is almost a perfectly automatic machine. The only attention it required is to add pure water to the electrolyte when evaporation requires it.

Short-circuits, even continued to a complete discharge, cause no injury, if charging is done immediately. A large battery after continual service of two years in the hands of an engineer who is a novice in batteries, shows no deposit in the jars. Of course there is no possibility of buckling.

In the case of a railroad battery installed by the writer, of an earlier type, a glass jar broke in the midst of a day's work, and was not discovered until the electrolyte was on the floor and came trickling through upon our heads. The battery continued its work as if nothing had happened, until we had ample time to jump that jar and replace a new one at leisure. Had it been the ordinary type of battery, the circuit would have been immediately broken and caused serious delay. But the pottery diaphragms being saturated, held and retained sufficient electrolyte for an hour to do the work of the road, with no noticeable difference.

Quincy, Mass. George E. Hatch.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

New Electrolytic Rectifier.—Grisson.—An illustrated article, describing the rectifier constructed by the author. Experiments conducted with cells containing a lead and an aluminum electrode, showed that the layer of oxide which prevents the positive current from passing, was soon destroyed, and that the hydrogen set free at this electrode, when it acts as a negative electrode, is the cause of this destruction. Chemical means of preventing the liberation of hydrogen proved ineffectual. It was observed that at vertical electrodes small holes formed on the aluminum electrodes, which gradually increased in diameter and at which a strong evolution of gas took place. Many experiments had shown that the formation of the protecting layer of alumina took place best when a small current density was used. An oxidation of the damaged layer of alumina appeared, therefore, feasible, if a sufficiently high resistance could be opposed to the passing of the current at these places. For this purpose the above-mentioned gas bubbles appeared suitable. The lead electrode was, therefore, arranged below the aluminum electrode, and both fixed in a horizontal position. When alternating current was sent into the rectifier and direct current taken out, there were formed gas bubbles below the aluminum electrode. These bubbles oppose so much resistance to the current that there is only a very small current passing at the places which are damaged, so that by this means a new layer of oxide can form under the gas bubbles, and the damage done to the covering can thus be repaired. The apparatus consists of four cells, each 30 cm high, 19 cm wide and 22 cm long. They are shown in the adjoining figure. The lead

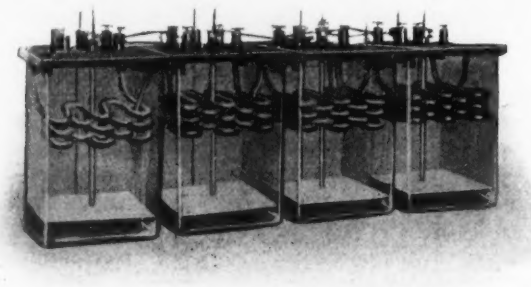


FIG. 1.—ELECTROLYTIC RECTIFIER.

electrode plate is arranged on the bottom of the cell, above it the aluminum electrode plate. In the upper part of the cell there is a cooling coil of lead pipe, in order to make it possible to keep a low temperature of the electrolyte, if the cell is working for a long time. For plants in which the voltage of the alternating current is higher than 110 volts and where a direct current of 110 volts or less is to be taken off, a specially-constructed transformer is used. An efficiency of over 60 per cent. when running on alternating current of 110 volts and taking off continuous current of 20 amp., is stated to have been obtained. Connection is made after the scheme illustrated in the diagram, in which the upper machine is the source of alternating current, 1, 2, 3, 4 the rectifier, *A* the aluminum electrode, *B* the lead electrode, and — + the place of consumption of the direct current. If the current from the alternator goes to the left, it cannot pass through cell 1 and therefore must go through cell 2. As the way through cell 4 is also closed, it can only return to the alternator by way of the place of consumption of direct current and through cell 3. The following impulse travels to the right, and as cell 3 is closed, it has to pass through cell 4, and as cell 2 is also closed, it must return by way of the place of consumption and through cell 1. (This arrangement seems to be the same as the well-known Wheatstone bridge system of connection.) If the cells

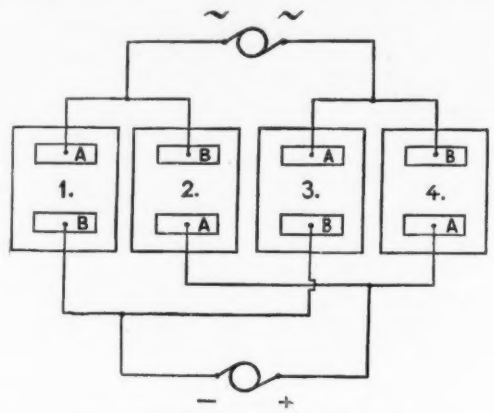


FIG. 2.—DIAGRAM OF CONNECTIONS.

are connected in the alternating circuit, without taking direct current from them, the amperemeter shows a value corresponding to the surface of the electrodes. This value, however, does not mean a loss of energy, but is attributable to the action of the cell as a condenser; the cells charge themselves and discharge with each change of polarity, without the passage of any current.—*Zeit. f. Elek.*, June 4.

REFERENCES.

Economy in Continuous-Current Design.—Purton.—A mathematical article in which the author shows how the problem of reducing the cost of construction of dynamos to a minimum without sacrificing the efficiency or good working of the machine, can be solved to some extent by the methods of analysis.—Lond. *Elec.*, June 5.

Electrolytic Rectifier.—An illustrated description of Nodon's apparatus, previously noted in the Digest.—*Elek. Zeit.*, May 29.

Lights and Lighting.

Recent Experiments on the Nernst Lamp.—Wedding.—A long article illustrated by diagrams and tables on experiments continuing over half a year and made under the conditions of practice with excessive change of voltage. The changes of voltage were so great that the first series of lamps was soon destroyed on account of it. A second series were investigated with a normal voltage of 220 volts and changes of pressure of + 10 and — 10 volts. Of the series of lamps for 220 volts and 1 amp., 9 lamps had already become damaged after 93 hours. A third series of 12 lamps for 220 volts were investigated, six of which had starting resistance for 30 volts and the other six for 20 volts. As far as the light is concerned, the two systems are the same after 150 hours' burning. The specific consumption is more favorable in the beginning for the glower with higher voltage, which burns with a thirty-volt resistance. After 200 hours of burning this relation is changed, and the lower voltage glowers show more favorable results, but the difference is not considerable. For the lamps with 20-volt resistance, the candle-power

of 158 candles at the start fell 20 per cent. after 275 hours, after 325 hours the candle-power has fallen 25 per cent., and after 550 hours the candle-power fell to one-half. A fourth series of twelve lamps were investigated as to their length of life and the results showed an average for the lamp of 220 volts of 730 hours. The author concludes from these results that not only have a great many advances been made in regard to the durability of the lamp, but that the durability which has been obtained now is sufficient for the demands of practice. The latter part of the article is devoted to the description of the latest form of the German Nernst lamp, and it is stated that the specific consumption is only 1.21 watts per candle. The author thinks that the Nernst lamp is primarily called upon to fill the gap between the carbon filament glow light and the arc light to about 6 amp, and considers in what direction further improvements are to be made.—*Elek. Zeit.*, June 4.

REFERENCES.

Connection of Arc Lamps.—KAUFMANN.—A short article, illustrated by diagrams, in which the author gives a scheme for the connection of 4 arc lamps to a 220-volt, direct-current circuit, so that one group of 2 lamps or all 4 lamps together may be used.—*Elek. Anz.*, May 24.

Arc Lamps for Interior Car Lighting.—An article describing an arc lamp in which the carbons are so held that the jolting of the car does not interfere with the steadiness of the light. The lights take 2⅛ amp., and it is proposed to carry 4 of these lamps in the interior of the car and one arc headlight, all in series on the 500-volt circuit, together with a resistance, or the headlight can be used on a separate circuit.—*St. R'y Jour.*, June 6.

Low-Voltage Incandescent Lamps.—ZACHARIAS.—An illustrated article giving some details of the manufacture of small incandescent lamps for 3 to 5 volts, as used in connection with dry cells.—*Centraibl. f. Accum.*, April 1.

The Incandescent Lamp.—A didactic article with illustrations, on the incandescent electric lamp, dealing principally with the illuminating power, current consumption and life of the lamp.—*Am. Elec.*, May.

Incandescent Lamps.—A brief illustrated article on the different steps in the manufacture of the electric incandescent lamp.—*Dingler's Polyt. Jour.*, May 9.

POWER.

Electrical Driving in Factories.—HICHFIELD.—The first part of a paper read before the Manchester Local Section of the I. E. E. on the possible developments of electrical driving in factories due to the supply of electricity at cheap rates by large power companies. The author discusses the question of how large power companies can furnish electricity cheaper than private plants. He considers that a central supply company has an especial advantage over the latter, if it uses gas engines in place of steam, as in nearly every case it can operate on a sufficiently large scale and a sufficiently constant load to enable large gas producers to be used in connection with the recovery of the sulphate of ammonia. He considers that as about 90 pounds of sulphate can be obtained from every ton of coal, an immense set-off can be made against the coal bill.—Lond. *Elec.*, June 5.

The Steam Turbine.—RANCOUR.—A long article, with diagrams and tables on the Parsons turbine, discussing in detail its various advantages as compared with the steam engine. In order to show how quickly these turbines can be set up, the author states that an installation of 300 effective horse-power for furnishing electricity to the city of Croire, had been in full operation four days after its arrival at the railroad depot. A turbo-alternator system of 1,400 hp is said not to take more than eight days for erection, while for a steam engine of 1,400 hp at least three months should be allowed.—*La Revue Technique*, May 25.

Electric Motors for Gas Works.—A note on the electrical equipment of a new gas works in Milwaukee. An electric plant driven by gas engines furnishes power to various auxiliaries throughout the works, all of which will be operated by electric motors, and to a large machine shop, also operated by electric motors. Coal will be unloaded from boats, and elevated to the storage bins by electric hoists and conveyors, the retorts will be charged and drawn by electric appliances, and the final disposition of the coke will be accomplished by electric power apparatus. The system will operate at 250 volts direct current.—*Prog. Age*, June 1.

REFERENCES.

Motive Power for Small Isolated Plants.—LOMBARD.—The author describes a new system of furnishing gas for small motors, invented by Riché. The gas is made by distilling wood, sawdust, straw, etc., in vertical cast-iron retorts. Several instances are mentioned, in which the system has been used for electric lighting purposes in small cities and isolated localities.—*La Revue Technique*, May 25.

Plant of the Cascade Water Power and Light Company.—An illustrated article on the installation of the above company at Cascade, B. C., for the utilization of power from the Kettle River; 20,000 volts are transmitted for 21 miles for various power and lighting purposes. —*Can. Elec. News*, May.

Power Station.—An illustrated description of the electric power station of the Dominion Iron & Steel Company, at Sydney, Nova Scotia. Gas from the blast furnaces of the company is used for generating steam.—*Can. Elec. News*, May.

Railway Power Plant.—BURCH.—An illustrated article on the design of the new power plant and system of the Everett Railway & Electric Company, at Everett, Washington, supplying incandescent and arc lighting, electric railway and power service.—*St. R'y Rev.*, May 20.

Power Plant of the Philadelphia & Reading Railway, at Reading. —An illustrated article describing the plant for furnishing power for the machine tools in the shops of the above railway.—*Am. Eng. & Railr. Jour.*, June.

San Francisco Power Plant.—PERKINS.—A short, illustrated description of the power plant and the sub-stations of the United Rail ways, of San Francisco, Cal.—*Elec. Rev.*, May 30.

Electric Power Plant Below Mount Rainier.—MAYO.—A short article describing the power station which is being constructed to utilize the glasier flow of Mount Rainier, which will deliver energy to the principal cities of Washington. Alternating current of 2,500 volts will be generated and stepped up to 45,000 or 55,000 volts and then transmitted 30 miles to Tacoma, and 45 miles to Seattle.—*Scien. Am.*, May 23.

Power Plant of the Neversink Light & Power Company.—An illustrated description of the plant, drawing 1,000 hp from the Neversink River, which power can be increased to 1,500 hp for 6 hours by means of a reservoir, which is filled during light loads. Three-phase alternating current at 600 volts and 60 cycles is generated and stepped up to 10,000 volts to the distribution centers, where it is stepped down again.—*Eng'ing Record*, June 6.

Ouray Electric Light & Power Plant.—PERKINS.—A short illustrated article.—*Electricity*, June 3.

Mechanical Applications of Electricity.—RICHARD.—An illustrated article on some recent improvements in mechanical applications of electricity, especially in connection with its use in steel works.—*L'Eclairage Elec.*, May 9.

Electric Power in the Iron and Steel Industries.—WALSH.—A short, popular article.—*Elec. Rev.*, May 30.

Electric Hoisting Engines for Mines.—An illustrated description of engines recently installed at two German mines.—*Der Electrotechniker*, May 15.

TRACTION.

Magnetic Surface Contact Systems.—PAUL.—An illustrated article dealing with the Diatto and the Lorain systems. The author concludes that the maintenance of the electrical portion of the equipment in the magnetic surface contact system is far too high in comparison with other systems. The rather high weight of the current collector fitted with the heavy magnets and the lack of sufficient flexibility of the collector, necessitates the latter being pressed comparatively hard on the contact studs in order to insure a proper contact. In consequence of this an excessive wear will take place, involving not inconsiderable expense. The losses of energy caused by the carrying of the weight of the collector and by the magnetizing of the magnets, have to be taken into consideration. The maintenance of the accumulator battery in each car is also an item which cannot be set aside. In making a comparison between the Diatto and the Lorain system, the conclusion is arrived at that better results can hardly be anticipated from the latter as long as the fundamental faults of the system are not removed. These faults include, first, insufficient safety for the public traffic, owing to the ineffectualness of the safety device, and second, the high maintenance charges for the track work in consequence of the great wear of the contact

studs with their apparatus and the time-consuming inspection required, owing to the nonesparkless working of the latter.—*El. Eng.*, London, May 29.

English Versus American Conduit Railway Construction.—An editorial considering the conduit railway construction in London. The type of conduit differs from that in New York and on the Continent. The center slot is used, and in this respect American practice is followed, but the service rails are not supported on the yokes. The American construction has greater transverse strength, but this is necessary in America, due to the range of temperature and its effect on the pressure on the pavement. There is also a short reference to storage battery installations.—*St. R'y Jour.*, June 6.

The Generating Plant of the Montreal Street Railway Company.—Mershon.—This company is now purchasing 5,000 hp from a water plant 16 miles from the city. Power is supplied at 66 cycles, quarter-phase, and is converted to direct current. The first installation consisted of a 500-kw synchronous motor and generator, but six induction motor-generators were afterwards ordered. A diagram of the circuits of the latter is shown. The induction motors are considered preferable to the synchronous motors, as less care, attention and skill is required in operation, and there is less disturbance to the system of the power company. The induction motors are among the largest that have ever been built and the installation is the largest composed entirely of induction motors.—*St. R'y Jour.*, June 6.

REFERENCES.

Freight Car Driven by Induction Motors.—Weeks.—The author discusses the advantages of a car for freight service in the factory where belt and chain conveyors fail to fill the requirements and describes the construction and operation. The arrangement is simple and a number of diagrams illustrate the more important electrical features.—*St. R'y Jour.*, June 6.

Three-Phase Railway at Valtellina.—An illustrated article on the road recently installed in Italy and repeatedly referred to in the Digest.—*St. R'y Jour.*, May 30.

Metropolitan Electric Traction of Paris.—An illustrated, popular article, describing the equipment of the three generating stations and the various sub-stations.—*Cosmos*, May 23.

London County Council Tramways.—Conclusion of the illustrated article previously noted in the Digest, giving illustrations of rolling stock and diagrams of car wiring.—Lond. *Elec.*, May 29.

Los Angeles and Pacific Electric Railway System.—The first installment of a long, well-illustrated article, dealing with the organization of the companies concerned, the various power plants and sub-stations.—*St. R'y Rev.*, May 20.

Electric Brake for Street Railway Service.—A description of a brake cylinder worked by electric power instead of air power. The amount of current required is 4½ amp. The controller is arranged with five notches, which provide for different amounts of resistance in circuit.—*St. R'y Jour.*, May 16.

New Shallow Conduit.—Smith.—An illustrated description of the author's shallow slotted conduit construction on traction systems. Some editorial criticisms are made in a foot note.—Lond. *Elec. Eng.*, June 5.

Electric Haulage on Canals.—Perkins.—An illustrated description of various systems in use in this country and abroad, and already noticed in the Digest.—*Elec. Rev.*, June 6.

Installations, Systems and Appliances.

Electricity Supply in Milan.—An illustrated article describing the power house of Porta Volta. The current for lighting, traction and power is furnished by hydraulic works at Paderno and by a steam plant at Porta Volta. Paderno furnishes 8,000 kw at 13,000 volts, while Porta Volta generates 10,000 kw at 3,600 volts, 20 transformers of 400 kw each transform the Paderno current at Porta Volta to 3,600 volts to permit of working in parallel with the steam plant; 12 boilers of 14,000 aggregate hp furnish steam for 3 compound engines of 1,000 hp each, a 2,200-hp triple-expansion engine, and 2 steam turbines of 3,000 and 4,500 hp. A switchboard is being installed 130 ft. long and 14 ft. deep. The distribution system is two-fold, first to a three-phase, 3,600-volt network, which serves to supply the greater portion of the city, including a large industrial area. The second subdivision goes to supply a sub-station, where the motor-generators are installed, which furnish continuous current for the central section of the city, 125 volts between each side of the three-wire system. The conversion of the three-phase to 550 volts continuous current for traction purposes is also effected here. The plant consists of five motor-generators of 550 kw each, the actual maximum demand sometimes reaching 2,500 kw. For the lighting load there are seven similar sets of 250 kw each, and two smaller sets of 60 kw each. One of the most striking features is the enormous capacity of the batteries, of which there are 4 for the lighting system, each of which has a maximum discharge of 4,680 amp. at 140 volts. A fifth battery of equal capacity is in course of construction. The buffer battery for the tramway has a maximum one-hour discharge of 3,800 amp. The second part of the article deals with the charges made for service and the character of the load. Diagrams of the latter are given.—Lond. *Elec.*, May 29, June 5; and *Elec. Eng.*, May 29.

Design of Central Station Records and Returns.—Davies.—A long article giving the author's ideas as to what books should be kept at a central station. The first book referred to is a diagram book, clearly showing all the cable and pipe work connections strictly up to date. Besides main connections it should contain diagrams of any motor starters or similar apparatus, that may be installed in the station. Daily load curves should also be taken, showing the output in kilowatts over the 24 hours. Cost curves should be constructed, showing the cost of coal, oil, waste, water and engine room stores; wages, repairs and maintenance. A daily log sheet should show the readings of the various instruments, the majority of the readings being taken at least every half hour during light load and every quarter of an hour during the rest of the day. Feed water temperatures should be read by the stokers at stated intervals. The whole sheet should show the following items: Total units generated; units put into battery; units taken out of battery; efficiency of battery, watt-hour and amp-hour; units used on works; units sent out; pounds of coal per unit generated; pounds of water evaporated per pound of coal consumed; evaporation from and at 212° F. A battery log book should consist of a daily record of the battery charge, discharge and efficiency, and the results of a weekly examination of the battery, specific gravity and volts. Among the other books considered by the author are engine and boiler hour records, balancing book, free wiring book, house service costs, meter cards and books, canvassing records, meter testing records, main testing records, indicator cards, weekly and quarterly returns and balance sheets.—*Elec. Eng.*, May 8.

Electric Works of the City of Vienna.—Fach.—A very long, illustrated article. The city owns two works, situated beside each other, one for the supply of current for traction and the other for lighting purposes. Both can be connected together and furnish 3-phase current at 5,500 volts. For the inner sections of the city and for traction purposes the current is transformed by motor-dynamos. In the traction central station steam is furnished by a battery of 20 Babcock & Wilcox boilers, at 14-atmosphere pressure. The engines are quadruple-expansion, furnishing normally 3,000 and a maximum of 3,720 hp at 90 r.p.m. The outside diameter of the stationary armature is 30 ft.; the revolving field is nearly 25 ft. in diameter and carries 64 poles. The number of alternations is nearly 96 per minute. A small separate engine is arranged to start the field to revolve until the engine has sufficient power to turn it. A motor-dynamo is provided for the excitation of each two generators. There is also a battery of 120 cells, with a maximum charge and discharge current of 252 amp. and a guaranteed capacity of 756 to 1,015 amp-hours at 3 to 10 hours' discharge.—*Zeit. f. Elek.*, May 24.

REFERENCES.

Storage Battery Plant at Milwaukee.—An article describing the storage battery plant of 608 cells, installed in the main power house of the company, which supplies light and street railway service to the city of Milwaukee. The batteries are used as a reserve for either lighting or the railway service, and a number of combinations for their employment are possible.—*St. R'y Jour.*, June 6.

The Baltic Mercantile and Shipping Exchange, London.—An illustrated article on the electrical installations in the new building.—Lond. *Elec. Rev.*, May 29.

Electro-Physics and Magnetism.

REFERENCES.

Terrestrial Magnetism and Atmospheric Electricity.—The last issue of this quarterly journal contains the following articles: Amundsen, the proposed Norwegian expedition to the magnetic North Pole; Hazard, mean values of the magnetic elements at observatories; Farr, the Christchurch Magnetic Observatory, New Zealand; Bauer and Fleming, the magnetic observatories of the United States Coast

and Geodetic Survey in operation on July 1, 1902; Abbe, Tromholt's catalogue of Norwegian auroras, and a number of abstracts and reviews.—*Terrest. Magn. & Atm. Elec.*, March.

Notes of X-Light.—ROLLINS.—The continuation of the author's notes relating to an improvement in the way of attaching the terminals of the X-light tube to the electric generator and observations on metal tubes between the x-light tube and the patient for improving the definition of the photograph.—*Elec. Rev.*, June 6.

Improved Forms of Support for X-Ray Tubes.—ROLLINS.—An illustrated article showing in detail the improvements devised by the author in supports for the X-ray apparatus, in order to adapt them better to the taking of X-ray pictures, especially for medical purposes. —*Elec. Rev.*, May 30.

ELECTRO-CHEMISTRY AND BATTERIES.

Anodes for Electroplating.—BURGESS AND HAMBUECHEN.—An illustrated article in which the authors point out some of the factors which influence the corrosion of the anode during electrolytic action and give the results of some measurements made with nickel anodes in a nickel-ammonium sulphate plating solution. The lower the current density at the anodes, the more nearly does the amount of metal corroded correspond with the electrochemical equivalent, and especially is this the case with nickel. With commercial nickel the current density must be kept below 5 amp. per square foot in order that a high current efficiency of corrosion may be attained. To obtain a suitably low current density at the anode, corrugated and round or oval anodes have been introduced. The authors have made experiments on the variation of the current density over the surface of flat rectangular and oval anodes, the results being given in diagrams. With the rectangular cross-section, the distribution of current is much less uniform over the entire surface than with an oval cross-section. The authors point out the following advantages of oval anodes. The oval electrode has a larger ratio of active to total anode surface than the flat rectangular anode. The corrosion takes place in such a manner that the electrode retains its original shape, until it is reduced to a very thin rod or strap; on this account the amount of scrap of oval anodes is only about 5 per cent., against 15 per cent. with flat rectangular anodes. While oval electrodes may require a greater amount of nickel to be suspended in the tank, the disadvantage is only in the increased interest on the investment, and this item is more than compensated by the saving in the less frequent removal of the electrodes and the smaller amount of scrap. A further advantage of the oval electrodes is the fact that a more dense casting may be obtained than where the anodes are made flat and thin.—*Electrochem. Ind.*, June.

The Electric Furnace.—WRIGHT.—A popular description, with numerous good illustrations of various types of the older arc and resistance furnaces, treated chiefly from a historical point of view. The well-known Heroult furnace is classed by the author as an arc furnace, and the process taking place in it is said to consist in the fusing out of metallic aluminum by the heat of the arc, leaving the oxygen of the alumina free to combine with the carbon of the electrode. (This explanation is, of course, wrong, as in the Heroult furnace, as well as in the Hall furnace, the alumina is dissolved in a bath of molten cryolite, and electrolysis takes place, the aluminum going to the cathode and the oxygen going to the anode. The electrolyte is kept fluid by the heat of the current and the furnace must, therefore, be classed as a resistance furnace.) Some carbide furnaces, mostly of the older types, are described and illustrated; those of the rotary type as used by the Union Carbide Company, are not mentioned. The author states that the process of conversion in the Acheson carborundum furnace is said to be far from economical. (It is hard to reconcile this statement with the fact that Acheson has been manufacturing carborundum on a commercial scale for a number of years, and has repeatedly extended his works.)—*Cassier's Mag.*, June.

Voltaic Potential Difference.—BROWN.—An account of some experiments made to test the hypothesis that the difference of potential observed at the surfaces of dissimilar bodies in the fundamental experiment of Volta, is due to the chemical action of films, which are condensed on their surfaces from the gaseous atmosphere surrounding such bodies. He used a couple consisting of a zinc plate and a copper plate, which has been well cleaned with fine glass paper; they were placed closed together and one was connected to each pair of quadrants of an electrometer. After momentarily connecting them together by a wire and then separating them in the usual way, in air, a deflection of 140 was observed. Oil sufficient to cover both plates was then poured into the apparatus, and on again connecting and separating the plates several times, the deflection averaged 110 divisions in the same direction as before. The oil bath was then heated to about 145° C., after which the connection and separation gave no deflection. The whole was then allowed to cool and again tested, but as before there was no deflection; the "volta effect" had disappeared. Its disappearance is apparently due to some effect of the heating, since the mere immersion in the oil did not cause it, and the absence is not due to temperature merely, since this absence continued after the oil had cooled. He contends that the volta effect ceased as soon as the condensed films were evaporated and considers this experiment as a confirmation of the condenser electrolyte-film theory.—*Phil. Mag.*, May.

Electrolytic Reduction of Chlorate of Potassium.—TOMMASI.—A note presented to the French Academy of Sciences, in which the author shows that he had long ago arrived at substantially the same conclusions as were obtained by the recent experiments of Bancroft, Barrows and Brochet.—*Journ. de l'Electrolyse*, May 15.

Non-Conductivity of Metallic Hydrides.—MOISSAN.—A note on a paper presented before the French Academy of Sciences. The author found that the hydrides of potassium, calcium and lithium are non-conductors of electricity. The conclusion is drawn, therefore, that hydrogen is not comparable to the metals, and that the hydrides cannot be regarded as definite alloys, of which they have neither the appearance or the properties.—*La Revue Technique*, May 25.

REFERENCES.

Electrochemical Analysis.—MOLTKEHANSEN.—An article on the separation of lead and manganese by electrolysis.—*Electrochem. Ind.*, June.

Apparatus for the Electrolytic Production of Chlorine and Bleach. —ULKE.—An illustrated description of the McDonald electrolytic cell and the installation of 50 of these cells at the Clarion paper mill.—*Eng. & Min. Jour.*, June 6.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Magnetic Detector for Hertzian Waves.—FLEMING.—This well-known investigator describes in a paper before the Royal Society an instrument, which will indicate and measure quantitatively the intensity of the radiations. The metallic coherer is of very little use as a quantitative instrument, as it is influenced by very slight accidental contact changes. The instrument constructed by Prof. Fleming consists of a pasteboard tube on which are placed six bobbins in series. In the interior of the tube are placed seven or eight small bundles of iron wire, each bundle being composed of eight well-paraffined wires. Each little bundle is wound over uniformly with a magnetizing coil and over this, but separated by one or two layers of gutta percha, is wound a single layer, forming a demagnetizing coil. The magnetizing or inner coils are connected in series, and the outer or demagnetizing coils are in parallel. Associated with this induction coil is a rotating commutator, consisting of four hard fibre discs on a steel shaft, which revolves at about 500 r.p.m., driven by an electric motor. They each have a strip of brass of a different length, secured to their circumference, and these serve to make and break the circuit of the magnetizing coils and to short-circuit the terminals of the secondary, while the magnetizing current is applied to one of the discs. The operations which go on during a complete revolution of the discs are as follows: First, the magnetizing current of a battery of secondary cells is applied to magnetize the iron bundles, and during the time this magnetizing current is applied, the terminals of the fine wire secondary coil are short-circuited, and the galvanometer is disconnected. Shortly after the magnetizing current is interrupted, the secondary bobbin is unshort-circuited, and an instant afterwards the galvanometer circuit is completed and remains completed during the remainder of one revolution. Hence, during a large part of the revolution, the iron wire bundles are left magnetized, but the magnetizing current is stopped and the galvanometer is connected to the secondary coil. If, during this period, an electrical oscillation is passed through the demagnetizing coils, an e.m.f. is induced in the secondary bobbin by the demagnetization of the iron, and causes a deflection of the galvanometer coil. Since the interrupter discs are rotating very rapidly, if the electrical oscillation continues, these intermittent electromotive impulses produce the effect of a continuous current in the galvanometer circuit, resulting in a steady deflection, which is equal to the demagnetizing force being applied to the iron, other things remaining equal. If the oscillation lasts only a very short time, the galvanometer makes only a small deflection; but if the oscillation lasts for a longer time, the

galvanometer deflection is larger and tends to become steady. Prof. Fleming thinks that this instrument will become of great use in connection with the design of radiators and transmitters for Hertzian waves for wireless telegraphy. The instrument promises also to be of considerable use in the investigation of the transparency or opacity of various substances to Hertzian waves, not merely qualitatively, but in the determination of a coefficient of absorption.—Lond. *Elec.*, June 5.

Indicator for Oscillating Currents.—Winkelmann.—A description of an instrument for demonstrating the existence of oscillatory curves and discharges. Two vertical vacuum tubes, mounted side by side are connected by a cross-tube, and carry electrodes in the tops of the tubes. A piece of corundum is arranged in the center of one bulb on a glass support, while the other contains a piece of scheelite, arranged in the same way. Under the influence of cathode rays, the corundum emits red light, while scheelite becomes blue. When a unidirectional current is passed through the apparatus, the cathode can be easily found by its action upon the mineral below it. If an oscillating current is passed, both minerals will show their respective color. To show the transition from one type of discharge to the other, both electrodes are joined to the terminals of an influence machine. If the discharging rods are pulled so far apart that no oscillations take place, the discharge is continuous. When the rods are near enough to allow the passing of sparks, both minerals will be affected.—*Zeitsch. f. Instrumentenkunde,* May; abstracted in Lond. *Elec.*, June 5.

REFERENCE.

Meters.—An article on the testing and certifying of electric meters by the Reichsanstalt; two meters by Aron have been admitted for certification; they are described; one is for direct current and the other for single-phase or polyphase alternating current; both are of the well-known pendulum type. In the second part four meters of Schuckert & Co., for direct current, are described. They are motor meters, based on the principle of the electrodynamometer.—*Elek. Zeit.*, May 14, 21.

Telegraphy, Telephony and Signals.

REFERENCES.

Improvements in the Different Systems of Wireless Telegraphy.—Prasch.—The continuation of an illustrated article, dealing in the present instance, with a description of the improvements made by the Italian captain, Bonomo, in the Marconi system, by the use of the Castelli coherer and a very careful insulation of the mast, the inductor and the source of electricity. A telephone is used as receiver. The Fessenden and the Lee-deForest-Smythe systems are also described.—*Dingler's Poly. Jour.*, May 23.

Wireless Telegraphy and Telephony.—Berthier.—A popular illustrated article discussing Zickler's system and the conditions for wireless telegraphy and telephony in general.—*Cosmos,* May 23.

Progress in Wireless Telegraphy.—Maver.—A popular article dealing with the historical development of the subject.—*Cass. Mag.*, June.

New Column Type-Printing Telegraph Instrument.—An illustrated description of the instrument designed by Higgins and used by the Exchange Telegraph Company, London.—Lond. *Elec.*, June 5.

Divided Multiple Switchboard.—Aitken.—The conclusion of the article previously noted in the Digest.—Lond. *Elec. Rev.*, May 22.

Designing of Telephone Apparatus.—Taylor.—The twenty-third installment of his long article.—*Elec. Rev.*, June 6.

Telephone Exchange.—An illustrated article giving a description of the new equipment of the exchange of the Ashtabula Telephone Company.—*Elec. Rev.*, June 6.

Magneto-Bell Troubles and Their Remedies.—Hyde.—A short article.—*Telegh. Mag.*, May.

Telephone Service Problem in England.—Quail.—A discussion of the conditions and suggestions for their amelioration.—*Teleph. Mag.*, May.

Miscellaneous.

REFERENCES.

Artemiev's Electrical Coat of Mail.—An illustrated description of the Russian physicist's "coat of mail," repeatedly noticed in the Digest, for protection against electric currents.—*Scien. Am.*, May 16.

Electrical Steering Gear.—An illustrated description of a new gear, similar to the hand steering type, with such alterations as to adapt it to electrical driving.—*Scien. Am.*, May 16.

Italian Works.—An illustrated description of the united company of Gadda & Co., Brioschi, Finzi & Co., in Milan. The firm build mostly three-phase alternators and motors. A 1,400-hp machine, in course of construction, is illustrated.—*Lond. Elec.*, May 22.

Instruction.—Barbillion.—A long, illustrated article describing the electrotechnical institute of the University of Grenoble, France.—*L'Eclair. Elec.*, May. 23.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. General meeting, Niagara Falls, June 29, July 3.

National Electrical Contractors' Association of the United States. Annual Convention, Detroit, Mich., July 14, 15 and 16.

Turret Form of Train Controller.

In Electrical World and Engineer of May 16, some details were given, with an illustration of the new form of Westinghouse multiple train control. We are now able to present a view of the apparatus, which shows its exterior appearance, and its position under the car very clearly.

As already noted, this new apparatus is of the electropneumatic type, and is in principle like that hitherto installed by the Westinghouse company. Within one compact structure of turret form have been grouped by Mr. Westinghouse the electropneumatic devices to operate a simple form of electric switch, including a safety circuit-breaker and automatic means for preventing the application of too great an electric force to the motors, thus saving electric current and insuring the smooth operation of trains.

The new controller is located in the small turret under the car, as shown in the illustration, and has a circuit-breaking power many times greater, it is said, than has been attained heretofore. Among the other advantages of this "turret system" are greater blow-out

TURRET TRAIN CONTROLLER.

capacity, greater uniformity of action, unequalled arrangement of contacts, an automatic accelerating device, and marked economy of space.

The electropneumatic apparatus, operating the switches individually, is of the same character as that employed by the Union Switch & Signal Company in its electropneumatic signalling system, an apparatus that has been subjected to years of severe and successful tests in connection with the signals on numerous railways throughout the country. The electropneumatic switches are operated progressively by the valves being so arranged as to admit air to their respective operating cylinders at the right time and rate to insure graduated acceleration of the train and also guard against sudden rushes of current. The organization is such that current in excess of a predetermined amount cannot be admitted to the motors, with a result, not only that the motors themselves are not subjected to undue strains, but the train is free from sudden and abnormal movements in acceleration. The valves may be adjusted so that any required degree of acceleration may be obtained.

The new control apparatus has all of the usual safety appliances, including the arrangement whereby the current is automatically cut off and the brakes are applied, in the event of an accident to the motorman. Its weight is from one-half to three-quarters of a ton per car less than before, with consequent gain in other directions.

Another new Westinghouse invention is the automatic coupler, which in one operation couples the air brake hose, the multiple unit system of electrical control, and the lighting and heating connections.

A Large Electric Mining Plant.

The Cerro de Pasco copper mines, in the Peruvian Andes, which are about to be developed on an huge scale by American capitalists, will be operated largely, if not entirely, by electricity. Contracts for engines, etc., have just been placed by Frank Klepetko, consulting engineer, Maritime Building, New York, who is acting on behalf of the Americans interested in the undertaking. F. B. Haggin, the Californian capitalist, whose New York offices are in the Mills Building, and J. J. McCune, of Salt Lake City, Utah, are the principal people concerned in the venture. The extensive copper deposits are said to underlie a mountain of silver ore, worked since 1630, but in a very primitive method. The mines are located at an altitude of 15,000 feet. It is estimated that in four years the production of copper will be 4,000 tons per month. This output will place Cerro de Pasco at the head of the copper producing concerns of the world. The late owners of the mines took no ore out that gave less than 20 per cent. It is now calculated that an average yield of 12 per cent. could be kept up for many years. Several million dollars will be expended in equipment. The construction of a railway from the coast to the mines, a distance of about 85 miles, has already begun.

A smelter is to be erected which will have an initial capacity of 1,000 tons a day. It will be equipped with two blowing engines, each having a capacity of 24,000 cubic feet per minute compressed to 17 pounds and designed with a view to electric operation by 1,500-hp motors. These engines will be built by the Nordberg Manufacturing Company, of Milwaukee, Wis. There will also be five Nordberg engines of 30,000 cubic feet capacity to be compressed to 2½ pounds. These engines will be of 350-hp each. For power purposes two 475-hp Nordberg engines have been ordered for direct connection to generators of 350 kw capacity each. The generators will be contracted for next week.

One Type of Westinghouse Induction Motor.

The Westinghouse type "F" motor is a variable-speed induction motor, especially suited for use where loads have to be carried at reduced speeds, or where heavy loads have to be started and gradually brought up to speed. Elevator and hoist work are typical examples of this kind of service. The cut herewith shows the motor to be compact and of substantial build. Its resemblance to the type "C" is quite strongly marked. The only noticeable difference is an extension of the shaft at one end to provide the collector and brush-holder.

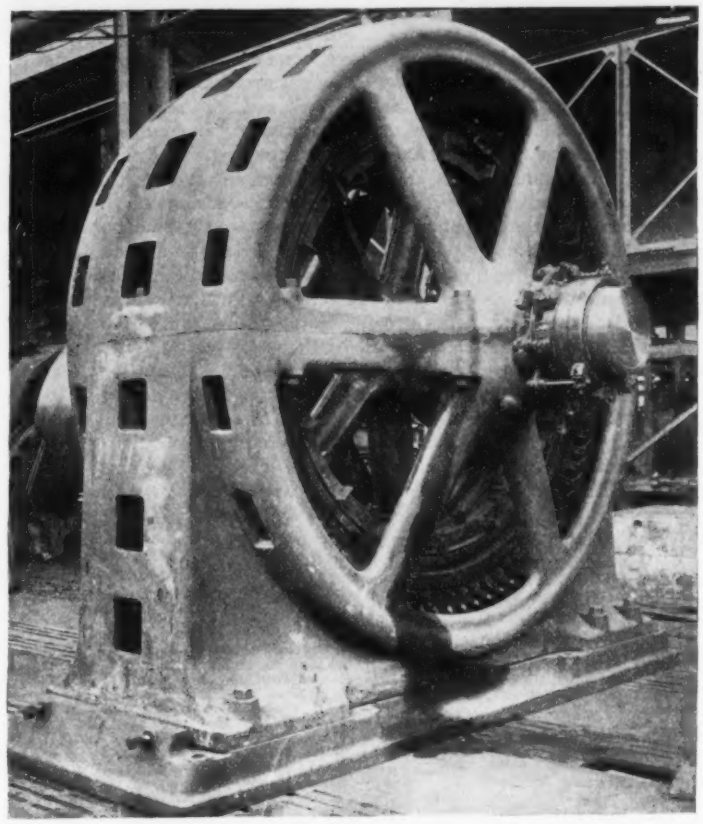
The motor differs from the Westinghouse type "C" motor in the secondary or rotating element, which is wound like the rotating part of a three-phase rotating armature generator, and carries a collector. Current passes from the collector to a rheostat through a controller, by which the speed may be varied by changes in the resistance.

The standard motors are provided with a hollow cylindrical frame of cast iron, in which the primary is mounted. The windings of the machine are completely protected by its frame from any external danger of accident. The frame forms a base for the machine and also supports the two and brackets carrying the self-oiling bearings. These have an ample bearing surface which insures small wear in the bearings.

The end brackets are bolted to the frame in any one of eight different positions, so that the oil chambers in the brackets will be in the proper position, whether the frame is bolted to the floor, the wall, the ceiling, or at a 45° angle. Supported from the bearing housing and readily accessible for such inspection or renewal of brushes as will occasionally be required, is a swivel type brush-holder, which allows rotation in either direction and the use of carbon gauze brushes. These require practically no attention, and the wear of the collector is reduced to a minimum. Motors of larger sizes are of the same general form, but the cast-iron frame for holding the primary is made in two parts, which are separated horizontally.

The primary element consists of a hollow cylinder built of laminated punchings of sheet steel, slotted on the inside to receive the conductors. The punchings are rigidly supported by the cast-iron housing that encloses the primary and forms the frame of the motor. In motors of larger sizes, the punchings are not continuous, but are made up of segments, dove-tailed into a hollow cylindrical shell of cast iron. This shell is held in the cast-iron frame of the motor.

The conductors are usually machine-wound coils of wire, which are thoroughly insulated before being placed in the slots. In some of the larger motors a copper strap, bent to the proper form, is used for the coils. In large motors wound for low voltages and heavy currents, a copper bar is placed in each slot, the insulated bar being slipped in at one end and the proper connections between bars made by short lengths of copper strap.



INDUCTION MOTOR.

The terminal blocks, through which the leads supply current to the motor, are connected to the primary winding and are located on the side of the frame.

The secondary element is built up of sheet steel punchings mounted upon a spider. The rectangular copper bars of the winding lie in partially closed slots around its periphery. They are grouped to give a three-phase winding, and the leads from the windings are carried through a hollow shaft to the collector.

These motors are usually built for two-phase or three-phase circuits, 60 or 25 cycles. The standard voltages are 200 and 400 and upwards.

Automobile Chairs at the St Louis World's Fair.

A concession has been granted to the Electric Chair Company, of St. Louis, to operate 2,000 automobile chairs at the World's Fair. Each chair will carry two passengers, one of whom may operate the machine, or, if desired, an operator will be furnished by the concessionaire. The chairs will be rented. Each machine will be provided with a detachable seat at the rear for the operator. The controller and steering bar may be placed either at the front or the rear, according to whether the machine is run by one of the persons hiring it or by an hired operator.

Mr. Semple S. Scott, an electrical engineer, is stated to be the inventor of this chair. The machine is provided with a new safety guard rail to prevent accidents. This rail entirely surrounds the machine and the slightest pressure on any part thereof causes an electric clutch to operate, which instantly brings the machine to a standstill, thus avoiding accidents.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was offered with moderate liberality, much of the output coming from foreign lenders. The demand for the long dates continued fairly active. The closing rates were 4 per cent. for 60 days, 4½ to 5 per cent. for 90 days to five months, and 5½ per cent. to 6 per cent. for six, seven and eight months. Speculation on the stock market was narrow and professional with more or less bearing manipulation. Recessions and rallies alternated, but the general tone was somewhat discouraged and declines in important stocks, notably United States Steel, occasioned temporary uneasiness. Rumors were current in this connection that some important interests in the corporation were liquidating their holdings to meet other obligations, and although this could not be confirmed, it had an effect on sentiment. Unfavorable sentiment was also created by the testimony brought out by the hearing of a suit to set aside the deal by the Metropolitan Street Railway list to the Interurban Rapid Transit, Metropolitan being heavy in consequence. In the industrials little interest was shown outside of the Steel stocks. Amalgamated Copper was irregular within narrow limits, but did not develop any special weakness on the intelligence that the demand for copper was slackening and that prices for the metal had fallen. Metropolitan Street Railway through the influences above noted, fell to the lowest point of the year—121¼, after having reached 126¼. There was a rally at the close, however, which brought the stock up to 124¼, this being a net loss of 3½ points. Brooklyn Rapid Transit declined from 58, the highest point, to 55, the lowest, the closing figure being 57, which was a loss of 1⅞. Manhattan Elevated closed at 136, being a drop of 3 points. Westinghouse common lost 1 point, closing at 194, and first preferred made a gain of 20 points, closing at 200. Western Union remained very quiet throughout the week, closing at 84, ex-div. Following are the closing quotations of June 23:

NEW YORK.

	June 13.	June 23		June 16.	June 23
American Tel. & Cable	77½	80	General Electric	177⅛	177⅛
American Tel. & Tel.	142	141	Hudson River Tel.	..	..
American Dist. Tel	27	27	Metropolitan St. Ry.	124½	124
Brooklyn Rapid Transit	56⅝	55¼	N. E. Elec. Veh. Trns.	⅛	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	18	17	N. Y. E. V. T. Co.	5¾	6
Electric Boat pfd.	37	40	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	1¾	1¾	Western Union Tel.	85	83¾
Electric Vehicle.	7	7	Westinghouse com.	189	188
Electric Vehicle pfd.	13¾	13⅝	Westinghouse pfd.	..	188

BOSTON.

	June 13.	June 23		June 16.	June 23
American Tel. & Tel	143	141½	Western Tel. & Tel. pfd.	92	90
Cumberland Telephone	..	..	Mexican Telephone	1¾	1¾
Edison Elec. Illum.	240	..	New England Telephone	125	128¼
General Electric	179	..	Westinghouse	..	..
Western Tel. & Tel.	13	12	Westinghouse pfd.	..	..

PHILADELPHIA.

	June 16.	June 25		June 16.	June 23
American Railways	..	..	Phila. Traction	96¼	96½
Elec. Storage Battery	..	63	Phila. Electric	6¾	6¾
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	8¼	8¾	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	June 16.	June 23		June 16.	June 23
Central Union Tel.	..	..	National Carbon pfd.	94	94
Chicago Edison	154	150	Northwest Elev. com.	..	..
Chicago City Ry.	190	197½	Union Traction	3	3½
Chicago Tel. Co.	..	..	Union Traction pfd.	30	30
National Carbon	23¾	23			

*Asked.

NEW YORK METROPOLITAN.—In view of the recent attacks on the Metropolitan Street Railway Company and the failure again of the latest, the following authoritative statement is of special interest: Leaving out of account the adjustments between the Interurban Street Railway Company and the Metropolitan Securities Company (which are of no practical importance, as the Securities Company owes the entire capital stock of the Interurban Company and the two concerns may, therefore, be considered identical, except for legal purposes) the position is as follows: The Securities Company has expended some $4,000,000 in acquiring the property and franchises of the Interurban Company, the People's Traction Company of New York, the Westchester & Connecticut Traction Company, the Wall & Cortlandt Street Ferry Railway Company, which it now owns, and for organization expenses, etc. The Interurban Company has agreed, under the terms of the lease with the street railway company, to furnish the latter company the sum of $23,000,000 in cash, partly for the purpose of paying off floating debt and partly for new construction, "electrifying" horse car lines, etc. For the first $10,000,000 paid by the Interurban Company to the street railway company, it received from the latter $11,000,000 of its 4 per cent. refunding bonds, which were sold for cash, realizing about $10,000,000. This left about $13,000,000 to be furnished to the street railway company, for which purpose, and to recoup the Securities company for its outlay for the acquisitions, etc., stated above, there have been called and paid on the shares of the Securities Company 50 per cent.; i. e., $15,000,000. As this money is paid over to the street railway company, the Interurban Company receives securities for the full value of its payments, thus far principally Third Avenue Railroad stock. It appears from the foregoing: (1) That almost the entire amount to be furnished to the street railway company has been provided. (2) That the Securities Company has received and now holds in its treasury securities equal to its payments to the street railway company—in addition to holding property and valuable franchises which it has acquired.

DECLINE IN WESTERN TELEPHONE.—Advices from Boston say that the decline in Western Telephone common from around 30 to 13 has been one of the marked features of the local exchange. The stock has sold as high as 33½. The decline in the preferred has meanwhile been comparatively small, from around 98 to 91. There is $16,000,000 of each class of stock issued. The outstanding bonds amount to $9,834,000. The preferred stock is entitled to 6 per cent. cumulative dividends after two years, the present rate being 4 per cent. There have been no dividends paid on the common. The net revenue reported for the shares for the fiscal year ending December 31, 1902, was $673,849, or $33,849 more than required to pay the 4 per cent. dividends on the preferred. The undivided earnings of the sub-companies were not reported. The Western Telephone Company succeeded the old Erie Telephone Company. The bonds and a portion of the preferred stock were issued to retire the old Erie bonds, while the remainder of the shares were issued in exchange for the $10,000,000 Erie stock, to retire $9,000,000 of floating debt, and to raise $6,000,000 of working capital. The value of the properties acquired was placed by Messrs. Stone & Webster, who made an appraisal, at $26,300,000, apart from franchises and rights of way, which have been estimated at $6,000,000 more. Western Telephone owns about 80 per cent. of the stocks of its sub-companies. None of the latter have bonds, except the Postal Telegraph Company of Texas, which has $1,189,000, and the Michigan, which has $5,594,000, including the Detroit Company. The Michigan also has a floating debt of $2,400,000. Deducting total bonds and floating debt of these sub-companies, $9,200,000, from the estimated value of the properties, $32,300,000, leaves $23,100,000. About 80 per cent. of this, or $18,500,000, represents the value of the equity of Western Telephone in the old Erie properties. The parent company has also a working capital of $5,500,000.

ALLIS-CHALMERS REPORT.—The report of the Allis-Chalmers Company for the fiscal year ended April 30 states that the surplus of $561,076 earned for the year, after payment of the preferred stock dividend, is equal to more than 2½ per cent. on the common stock. For two years the charges to capital have comprised only such expenditures as created additions to the plants for increased output, while all other costs have been charged against the current revenues. The company makes its purchases upon a cash basis, discounts its bills, and has no debts other than those incurred in the conduct of its current business. There is cash in bank amounting to $1,628,409, and, in addition, in excess of current liabilities, there are net quick assets of $6,243,333. The net gain in the second fiscal year in the quick assets was $391,325. The capital stock of the company remains as originally issued. Three of the great units of the West Allis works are now practically completed. Extensions of all other plants have also been made or are in progress. All the property of the company is owned in fee, is free from lien and is covered by insurance. No mortgage can be placed upon the property without the assent of 75 per cent. of the amount of preferred stock outstanding. The orders unfinished and on hand April 30 amounted to $8,797,483, as compared with $8,157,034 last year. The capital stock of the company outstanding remains, as originally issued, at $16,250,000 of 7 per cent. cumulative and 1 per cent. participating convertible preferred stock, and $20,000,000 of common stock. The report says: "The outlook for work was never better, and the business offered is greatly in excess of present facilities, which will soon be ample to meet the demand."

LARGER WESTINGHOUSE DIVIDENDS.—The Westinghouse Electric & Manufacturing Company has declared a dividend of ⅞

per cent. upon its preferred stock out of earnings from April 1, 1903, until May 15, 1903, and a dividend of 1¼ per cent. out of earnings from May 15, 1903, to July 1, 1903, making a total of 2⅛ per cent., payable July 10 next. The company also declared a dividend of 1¼ per cent. upon its assenting and non-assenting stock out of earnings from May 15, 1903, and July 1, 1903. Vice-President Kobbe, of the Westinghouse Company, in explanation of these dividends, stated that the action was in pursuance of the statements made in the circular recently issued to the shareholders to the effect that the dividends on all classes of stock would be adjusted so as to become payable on the same date. The character of the agreement establishing the preferences has made this necessary, because all classes of stock are entitled to the same rate when the earnings are sufficient to pay more than 7 per cent. The last dividend on the assenting stock was paid May 15 and the adjustment has been made from that date to July 1 at the rate of 10 per cent. per annum. The date of payment of dividends has been fixed for the 10th of the month succeeding the end of each quarter. There are only twelve non-assenting shares now outstanding.

CANADIAN MARCONI COMPANY.—The bill to incorporate the Marconi Wireless Telegraph Company of Canada was passed by the Railway & Telegraph Committee of the House of Commons at Ottawa, on June 18. The capital stock will be $5,000,000. Exception was taken to the clauses pertaining to the business of the company and to powers requested. Under these clauses it was said that it was apt to become the biggest trust in the world, the company getting power to go where it liked and to take over every business of a similar character. The clauses were amended by the addition of the terms "subject to the approval of the government in council and of the municipalities interested." The clause relative to charges for messages was amended to read that the company may collect such rates as are fixed from time to time by the government in council instead of the directors, as the company desired.

BELL TELEPHONE EARNINGS.—It is stated from Boston that the output of instruments by the American Company and its subsidiary companies is upon a tremendous scale and the net earnings of the A. T. & T. Co. for the first five months of 1903 amounted to $4,870,000 as compared with $3,556,323 for the same period of 1902, an increase of $1,313,720, or 28 per cent. These earnings are a demonstration that the new money which has been put into the property under the care of the new management during the past two years is beginning to receive its just returns.

DIVIDENDS.—The directors of the Union Switch & Signal Company have declared a dividend of 2¼ per cent. on the preferred stock and 1½ per cent. on the common, and have increased the capital stock $500,000, at 70 a share, payable 30 per cent. July 11, 20 per cent. August 15, and 20 per cent. September 15. The Electric Storage Battery Company has declared the regular quarterly dividends of 1¼ per cent. on both the common and preferred stocks, payable July 1. Bell Telephone Company, of Philadelphia, has declared a dividend of 2 per cent., payable July 25.

INDIANA TROLLEYS.—The Union Traction of Indiana and the Indianapolis Northern Companies have been merged into the newly-formed Union Traction Company of Indiana, with a capital of $1,000,000 preferred and $7,500,000 common. This will be leased in turn to the Indiana Union Traction Company, which will have $5,000,000 stock and $5,000,000 of bonds, and which will guarantee dividends at 1½ per cent. to start with, increasing to 6 per cent. in 1910.

CHICAGO TELEPHONE.—The Chicago (Bell) Telephone Company is pushing its service rapidly, and the total number of instruments out on June 1 numbered 88,080. The new stock for improvements is practically all subscribed for by old stockholders. Chicago telephone stock is now selling at 135, which is a decline of about 60 points in the last two years. It is thought due to the fact that its franchise runs out in 1909.

THE ATLANTA TELEPHONE & TELEGRAPH COMPANY, successor to the Standard Telephone Company, has filed a mortgage in Atlanta on all of its properties to cover a bond issue of $600,000 for improvements. The mortgage is given to the City Trust, Safe Deposit & Surety Company, of Philadelphia. The bonds are 5 per cent. and fall due May 1, 1923. The Atlanta company paid $750,000 for this property.

TO DEVELOP GAVIN FALLS.—The Manchester Traction, Light & Power Company, of Manchester, N. H., which is controlled in Boston, will increase its capital stock, $550,000, to $2,200,000, for the purpose of providing for improvements and new equipment and developing the Gavin Falls water power.

Commercial Intelligence.

THE WEEK IN TRADE.—From the reports received by the mercantile agencies it is evident that there is improvement in the crop, trade and labor conditions. Generally speaking, good railway reports continue; collections show gains, and money is easy, and there is a growing confidence that the crop movement in the fall will be handled without undue strain. Pig iron and steel are weaker; buying is still slow and production is at an enormous rate. Steel is easier and finished products are less active. Lead lost ½ cent, and tin is lower, but copper is ostensibly unchanged. An important but unexpected decline has materialized in lead; and cotton, owing to manipulative handling, has advanced, further complicating the position of manufactured goods. The long lock-out in the New York building trades unfavorably affects business in building material, stoves, gas and electric fixtures, hardware and a multitude of similar lines. Lumber is feeling the effects of existing strikes, and anthracite coal is called for more rapidly than it can be furnished. Copper was dull and lifeless, but there was a better inquiry from Europe. Quotations are nominal at 14a14½c. for Lake; 14a14⅛c. for electrolytic in cakes, wire bars and ingots, and 13⅝ a 13⅞ for cathodes and casting stock. The business failures for the week ending June 18, as reported by *Bradstreet's*, numbered 165, against 181 the week previous, and 177 the corresponding week last year.

FOREIGN AND DOMESTIC ORDERS FOR HARRISBURG ENGINES.—The recently formed engineering and contracting firm of Mackenzie, Quarrie & Ferguson, Incorporated, 114 Liberty Street, New York, which concern represents the Harrisburg (Pa.) Foundry & Machine Works in this section, has recently secured fair-sized orders for engines to be shipped, for lighting purposes, mostly to Mexico, Cuba, Japan and the Philippines. Numerous domestic orders have also been taken within the past few weeks for engines to be direct-connected to generators for light and power work. The Eddy Valve Company, of Waterford, N. Y., has ordered a 120-hp Harrisburg standard engine for direct connection to a 75-kw General Electric generator build. This outfit will be used for light and power purposes. A 150-hp tandem-compound to be direct-connected to a 100-kw General Electric generator, has been ordered for light and crane service in the Alleghany shops of the American Locomotive Company. The Berlin (Conn.) Construction Company has called for a 75-hp standard engine for direct connection to a 50-kw General Electric generator for light and power use. A 120-hp standard simple engine is to be shipped the Pennsylvania Salt Manufacturing Company, Philadelphia, for direct connection to a 75-kw Crocker-Wheeler generator for both light and power. Tufts College, Boston, Mass., has ordered for lighting purposes a standard simple engine for direct coupling to a 25-kw General Electric generator. Two 75-hp standards to be direct-connected to Western Electric generators of 50-kw capacity each will be installed for lighting service on the Market & Fulton National Bank Building, New York. The Jarvis Terminal Cold Storage Company, Jersey City, is to be supplied for light and power use with two tandem-compound engines —75 hp and 125 hp—for direct-connection to 50-kw and 75-kw Crocker-Wheeler generators. The Aluminum Press Company, of Plainfield, N. J., is to be shipped a 75-hp standard simple engine for direct-connection to a 50-kw Sprague generator for light and power. The Thames Iron Works, Wharton, N. J., have ordered two 300-hp standard tandem-compound engines for direct-connection to 200-kw General Electric generators, for power only. A small lighting outfit has also been ordered for St. Luke's Hospital, New York.

CURTIS TURBINES AT SCHENECTADY.—Upon the courteous invitation of the General Electric Company, the editors of a number of the technical papers in New York, escorted by Mr. E. H. Mullin, visited the works of the General Electric Company on June 19, with the object of inspecting the Curtis steam turbines—so fully described in our issue of May 23—and the preparations made at the works for their manufacture. The turbine department occupies the greater part of one of the large buildings at the Schenectady works, covering an area of 800 ft. x 90 ft., and about 400 men are employed. Even these facilities are scant for the orders on hand, which aggregate 185,000 kw, and the department is to be moved to a new building now being erected with an area of 240,000 sq. ft. Some of the processes used in the manufacture of the Curtis turbine are very interesting, such as the method of cutting the buckets in the solid steel discs and balancing the discs. Several different types of slotting machinery are used for cutting the buckets, but in all of them the tool is so guided that its cutting edge travels at such stroke over the exact curve to be reproduced. After the buckets are cut, a steel band is riveted around the periphery of the wheel. Each disc is balanced separately on the shaft and in the position in which it will be permanently mounted. Any unbalancing effect is deter-

mined by the flexure of the shaft when revolving rapidly, and weight is taken from the proper part of the wheel until a perfect balance is secured. A most enjoyable and instructive day was spent by the journalists.

THE COPPER MARKET.—Mr. John Stanton, who is interested in several large copper mining companies, and is well known in the trade, said last week: "I do not expect to see copper sell below 14½ cents a pound. The recent setback has been due to the stopping of work in the building trade because of labor troubles. The market will go higher as soon as the difficulties with labor end." The bears on copper lately emphasized the reported intention of the John A. Roebling Sons Company to shut down its plant one day each week, this being taken to signify that the demand for copper would show a material falling off, inasmuch as the company is one of the largest consumers of copper in the country. On this subject F. W. Roebling has written a letter in which he says: "Our copper wire business is practically up to that of last year, and we judge from our general knowledge of the situation that the demand for electrical apparatus will be about the same as it was last year. The number of operations calling for copper has been much reduced, but those which are projected and under way involve large quantities. There are a great many enterprises of magnitude under way and projected which will continue to call for large amounts of copper, and my judgment is that the total output will come very near being absorbed."

MEXICAN POWER TRANSMISSION.—Americans will construct a large hydroelectric plant in the State of Chihuahua for the purpose of generating current for transmission to the cities of Chihuahua and Parral, located 80 miles and 46 miles, respectively from the power house. The plant will be built at La Joya, on the Conchos River, by the Conchos River Power Company, of which Frank H. Wright, president of the Stanley Instrument Company, is the head. The company acquired the concession for the erection of the plant, which was originally granted by the Mexican authorities to R. M. Burke, formerly United States Consul in Chihuahua. Over 30,000 hp is available. Besides transmitting current to Chihuahua and Parral, the plant will furnish energy to operate mines along the route. The initial equipment will include four 800-hp turbine water wheels to operate under a head of 125 ft. The transmission line will work at 40,000 volts.

STEEL RAIL PRICE MAINTAINED.—After the meeting of the Executive Committee of the United States Steel Corporation last week the following statement was issued by Chairman E. H. Gary: "The prices of steel rails for the year 1904 has been fixed at $28, as the capacity of all the mills for the next seven or eight months has been sold. Many of the leading railroad companies have expressed a desire to have the prices of rails established for the next season, and action has been taken a little earlier than usual. Upwards of 250,000 tons for 1904 have already been booked, and inquiry for a large additional tonnage has been received during the day. No change in the price of other lines of steel has been contemplated." In general also the schedule of finished steel prices is unchanged for 1904.

EQUIPPING ENGINE WORKS.—The British Westinghouse Electric & Manufacturing Company, Limited, has secured the contract for the electrical equipment of the Northeastern Marine Engineering Company's Sunderland engine works. This contract includes the supply of a number of polyphase Westinghouse constant-speed and variable-speed induction motors, together with controlling gear, auto-starters and three-panel switchboard. Power will be obtained from the Sunderland Corporation Supply, this being the first plant to be connected up to the new polyphase generating plant, which runs at 220 volts and 50 cycles. The wiring for the installation will also be executed by the British Westinghouse Company. This will include both overhead and underground work, with distribution boxes and conduits.

FEEDER CABLE FOR SYDNEY TRACTION SYSTEM.—The National Conduit & Cable Company, Times Building, New York, has secured a contract for feeder cable for the city and suburban electric traction system, now being constructed by the New South Wales government at Sydney. Considerable equipment for an addition to the power house was expected to have been placed before this, but financial conditions in the Antipodes will not permit of further contracts being closed for the present. The contract for the initial installation was secured by the General Electric Company. The contract was worth about $800,000. The engines are of Allis build. The boilers are Babcock & Wilcox.

GROWTH OF FOREIGN TRADE.—For the month of May the exports of merchandise were valued at $100,508,051, and the imports at $78,935,143. The exports of the United States during the eleven months ended May 31, aggregated $1,324,493,293, and exceeded by $32,014,375 those of the corresponding period of the previous fiscal year. The imports for the same months show an increase of $113,391,300 and a total of $943,957,194, the highest on record; and for the first time will pass the billion-dollar mark when the fiscal year ends on June 30. The balance of trade in favor of the United States for eleven months is $380,896,099, against $462,273,024 for the same period of last year.

NEW YORK EDISON GROWTH.—Under its able and progressive management, the New York Edison Company grows steadily and of late has been finding itself rather pinched by the building strikes, etc., preventing delivery of new apparatus and the erection of necessary sub-stations. If it were not summer time, the delay in increasing plant for generation and distribution might be serious. Big as the Waterside station is, it is rapidly filling up, and the company even now is studying the problem of increased capacity. Another large station in the not distant future is already becoming a part of the programme under consideration by the executive officers.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY records that in one instance where 30 steam engines of 1,375 total horse-power were supplanted by 57 motors of 1,065 total horse-power, for machine shop driving, the average daily saving in steam was 41.6 per cent., of combustibles 32.2 per cent. (coal saved, 20,000 pounds). In other cases electric driving has reduced by 50 per cent. the cost for engineer, coal and water; the fuel account, 20 per cent.; the cost of power, 44 per cent. The gross saving was 30 per cent., with direct-connected motors, and 22 per cent. with belted or geared motors.

WESTINGHOUSE BRITISH ORDER.—The Westinghouse Company has secured a contract for the conversion of steam to electric motive power of another British railroad. The contract relates to the Wirral Railway, a system about 15 miles in length, which connects Liverpool by means of the Mersey Tunnel Railway —the electrification of which has just been completed by the Westinghouse people—and Birkenhead with the residential district of the Cheshire peninsula, bounded by the River Mersey and Dee. The terminal points will be West Kirby and New Britain.

THREE MEXICAN LIGHTING PROJECTS.—The American engineering and contracting firm of Fogarty & Dickinson, of San Luis Potosi, Mexico, has secured three contracts for the installation of electric lighting plants. One contract obtained from the federal and municipal authorities is for a plant in the city of Colima, State of Colima, which has a population of about 35,000. San Andres Chalchicomula, a small town in the State of Puebla, is to have a plant, and Tamazula, State of Jalisco, is also to be lighted. The equipments will be purchased in the United States.

BALL ENGINE CONTRACTS.—The Collins Sugar Company, Fort Collins, Colo., will install a plant, consisting of three engines of 725 hp, direct-connected to Crocker-Wheeler generators. The Ball Engine Company, Erie, Pa., furnishes the engines, which will be of the self-oiling type. The Ball Engine Company has also sold the S. W. Card Manufacturing Co., of Mansfield, Mass., a 100-hp self-oiling engine for electrical purposes.

MEXICAN ELECTRIC TRACTION SCHEME.—The construction by Americans of an electric railway between the city of Guadalajara and Lake Chapala is projected. Application has already been made to the Mexican authorities for the necessary franchise. B. F. Hammett and Felix Martinez, of El Paso, Tex., are primarily interested in the project. The system will be some 60 miles in length.

ST. LOUIS FAIR CONTRACTS.—The Commercial Electrical Supply Company, of St. Louis, has been awarded contracts for electrical material for the St. Louis Exposition, aggregating about $120,000. This material includes porcelain insulators, pole line supplies, receptacles, switches, police patron boxes and various other appliances to be installed on the grounds.

FRICTION DRAFT GEAR.—Over 100 per cent. increase in sales within twelve months is the record made by the Westinghouse Friction Draft Gear. One year ago 41,000 freight cars and 1,400 locomotives were equipped with this appliance. The number for freight cars is now over 80,000, and for locomotives in excess of 3,000.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Chicago, Ill., and Rochester, N. Y., has recently sold a magneto switchboard to the Deerfield Telephone Company, North Benton, Ohio; also a large number of bridging telephones to the Clinton Telephone Company, of Wilmington, Ohio.

WESTINGHOUSE ARRESTERS FOR CHINA.—Several Westinghouse lightning arresters have been ordered through Fearon, Daniel & Co., of China, New York offices 96 Wall Street, for shipment to the Shanghai municipality for use in the electric lighting system of the foreign settlement of that Chinese city.

MEXICAN TELEPHONE PROJECT.—A telephone system is to be constructed between Tepehuacan and Tamala, both in the State of Hidalgo. The state government will subsidize the undertaking.

General News.

THE TELEPHONE.

WOODBERRY, ARK.—The Eastern Telephone Company has 25 telephones and 75 miles of toll line, with as many more projected. This line is to run from Fordyce to Eldorado.

AUGUSTA, GA.—Archibald Blackshear has been made permanent receiver of the Augusta Telephone & Electric Company. He has been instructed to continue the operations of the company.

BLUE RIDGE, GA.—The Blue Ridge Telephone Company operates a 100-drop board with 140 subscribers and has 40 miles of toll line. It is now opening a small exchange at Elligay with a 50-drop board, and will have nearly 50 subscribers there.

PRESTON, IDAHO.—The Oneida Telephone Company has 18 subscribers and excellent prospects for a big mileage, as it proposes branching out in every direction to take in all the small towns in this section, eventually reaching Ogden and Salt Lake.

COAL CITY, ILL.—The Interstate Telephone & Telegraph Company has been granted a franchise in this city.

CROPSEY, ILL.—The Cropsey Telephone Company has a 100-drop board and 180 subscribers. Its rates are $6 per year.

SHELBYVILLE, ILL.—The Shelby County Telephone Company operates a 200-drop board and has 230 subscribers. It also has 100 miles of toll line.

MOLINE, ILL.—The Central Union Telephone Company has just installed a hotel system of 100 instruments in the new Manufacturer's Hotel, the first of the kind in a city of this size.

ARCOLA, ILL.—The Arcola Grain, Coal & Telephone Company has been incorporated with a capital stock of $5,000. It will operate a telephone system. The incorporators are Joseph H. Ewing, John I. Hall and Joseph Coombe.

TAMAROA, ILL.—The Tri-County Telephone Company has a 60-drop board with 45 city subscribers and 15 country lines. By the end of the year 100 telephones will be installed. There are 1,000 miles of toll line. The size of the switchboard is to be doubled in the near future.

MORRISON, ILL.—The Whiteside County Farmers' Mutual Telephone Company is a new and highly prosperous concern, having a 100-drop board, 85 subscribers and about 75 miles of toll line. There are lines in Whiteside and Henry counties with an exchange at Prophetston of about 300.

WEST BROOKLYN, ILL.—This plant is owned by Mr. F. M. Yocum, who bought it last April, with one at Compton, including 10 miles of grounded toll line. He is rebuilding the toll line full metallic and holds contracts for more farmers' lines than can be completed this year. This place has a 40-drop board with 40 subscribers.

HARDIN, ILL.—The Calhoun Telephone Company, besides having a 75-drop board here, has others at six different places with 200-drop board capacity. It has 150 exchange subscribers and 200 on toll or farm lines. There are 100 miles of toll line. Rates are $1 for residences, $1.50 for business houses. A 50-mile metallic circuit will soon be completed.

GARRETT, IND.—The Garrett Telephone Company will not commence operations till October, but will then open under very bright auspices.

NEW LISBON, IND.—The New Lisbon Telephone Company has a 50-drop switchboard capacity and 210 subscribers. The rate is $1 per month.

PERU, IND.—The Peru Home Telephone Company operates a 3000-drop board with 859 subscribers and has 40 miles of toll line. A large increase is projected.

CROTHERSVILLE, IND.—The Jackson Telephone Company has two exchanges of 50-drop capacity each. There are 64 subscribers and 40 miles of toll line with more projected. Rates are $12 per year.

GENEVA, IND.—The Geneva Telephone Company is in first class shape, being unable to make country extensions as fast as applications come in. It operates a 150-drop board and has 144 subscribers. Rates are $1, $1.25 and $1.50.

CLINTON, IND.—The Clinton Telephone Exchange operates Sterling apparatus. It has a 350-drop board and 500 subscribers. It has 40 miles of toll line. The rates are $1.25 and $2. Improvements and additions are to be made in the near future.

NAPPANEE, IND.—The owner of the Nappanee Telephone Company, Mr. C. R. Stoops, has a most progressive property. The switchboard capacity is 200 drops, there being 205 subscribers. Rates for residences and farms, $12—business houses, $18. Farmers' lines are being built.

KNIGHTSTOWN, IND.—The Knightstown Telephone Company reports the outlook more favorable than at any time during the past 10 years. It operates a 370-drop board and has 465 subscribers. There are 80 miles of toll line and the cable capacity is to be increased. Rates are $18, $15, $12, $9, $6 and $3 per year. With the advent of farmers' co-operative companies the number of telephones increases rapidly and this, with the low annual rates, gives a stimulus to the business, heretofore unknown.

MARIETTA, IND. TER.—The Red River Telephone Company operates 107 miles of toll lines.

AL-LU-WE, IND. TER.—There is a private line from this place to Nowald, which has been in operation several years.

DUMONT, IND. TERR.—The Chickasaw-Choctaw Telephone Company operates a 200-drop board and has 173 subscribers. There are 102 miles of toll line. Increase has been rapid and further business is projected.

TAHLEQUAH, IND. TER.—The Cherokee Telephone Company uses Stromberg-Carlson apparatus, has a 340-drop board and 160 subscribers. There are 35 miles of toll line at 25c. per message and exchange rates are $1.50 and $2 per month. This company expects to double its business in another year.

HANCOCK, IA.—The Hancock Telephone Company has a 100-drop board and 105 subscribers, and is soon to extend its business.

FORT DODGE, IA.—The Fort Dodge Telephone Company operates a 900-drop board, has 920 subscribers and 100 miles of toll line. Rates are $1 and $2.

CONROY, IA.—The Iowa-Hilton Telephone Company operates a 24-drop board and has 100 subscribers. The company has all bridging lines and is gaining all the time.

MONROE, IA.—The Monroe Telephone Company commenced operations less than a year ago. It has a 200-drop board of Eureka make, and 380 subscribers at $1.50 per month. An increase is projected.

ELDRIDGE, IA.—The Eldridge Mutual Telephone Company uses extension bells and has 72 subscribers. It is capable of taking care of two or three hundred, and operates also country party lines.

LISBON, IA.—The Lisbon Telephone Company operates an Eureka 200-drop board and has 140 subscribers in and 300 on country lines, of which there are 150 miles. Rates are $18 for business, $12 for residences.

MARSHALLTOWN, IA.—The Marshall Telephone Company operates Stromberg-Carlson apparatus; has a 1200-drop board with 900 subscribers and 70 miles of toll line. The outlook is very bright both in exchange and toll line business.

BATTLE CREEK, IA.—The Battle Creek Telephone Company operates a Eureka switchboard of 200 drops and has 98 city and 160 country telephones at $18 per annum. The service has been doubled this year and five more party lines are projected.

DEWITT, IA.—The Dewitt Telephone Company uses a full metallic system. It has a 200-drop board with 350 subscribers, paying $12 and $18 per annum. The outlook is bright for 500 city and country subscribers. Party lines bring in 10 to 16 farmers on a line.

HAWARDEN, IA.—The Hawarden Telephone Company has a switchboard capacity of 320 lines and 150 subscribers at $1.75 for business, $1.25 for dwellings and $1.25 for farmers. The company expects to construct toll lines to all parts of the country as soon as possible.

LINEVILLE, IA.—The Lineville Telephone Company has a board here of 147 drops, 100 at Garden Grove, 25 at Wildon and 40 at a town in Missouri. The number of subscribers in the four towns and country is 965. Rates are $10 and $12 per year. The system seems likely to extend to 1,500 telephones in the next two years.

MT. AYR, IA.—The Mt. Ayr Mutual Telephone Company has switchboard capacity of 200 drops and 30 farm lines. There are 175 subscribers at $1.25 per month. A new cabinet of 100 drops is to be put in soon and prospects are good for 500 subscribers at no distant date. At present this office has direct connection with 420 farmers' telephones.

BELLEVUE, IA.—The Bellevue Telephone Company operates a 100-drop board, has about 100 subscribers and 15 miles of toll line. An effort is being made to effect a consolidation of all companies operating in Jackson and Jones counties to be known as the Iowa & Illinois Telephone Company, which would enter Illinois and make through connections from Dubuque to Davenport, Rock Island, Moline and Chicago by copper Bell lines.

CLIFTON, KAN.—The Clifton & Vining Telephone Company supplies service to 148 subscribers from a 150-drop board. There are 140 miles of toll line and 25 farmers' lines. The charge is 25 cents for 5 minutes on toll lines.

LOGAN, KAN.—The Logan Telephone Company operates a 150-drop board with 75 subscribers. There are 37 miles of toll line and 22 more projected. Farmers' lines will doubtless soon be built over a large section of the country.

WICHITA, KAN.—The Wichita Independent Telephone Company has a switchboard with a capacity of 5,000 lines. It has 2,000 subscribers. This plant has only been in operation six months, but its business is gaining every day.

HERINGTON, KAN.—The Herington Telephone Company has switchboard capacity of 200, and a toll board of 10 lines. There are 200 subscribers at a 15c. rate in the country; $1 and $2 for residences and business houses. An increase of party lines is projected.

WELLINGTON, KAN.—The Wellington Independent Telephone Company operates a 500 "American" drop board, has 439 subscribers and 125 miles of toll line. The company has just bought out Belle Plains with 70 telephones and 79 farmers' lines. Lines are run into every town in the country.

WETMORE, KAN.—The Wetmore Telephone Company employs two switchboards of 100 drops each. Stromberg-Carlson and American apparatus is installed. There are 150 subscribers and 75 miles of toll line. Rates are $12 for residences, $15 for business houses. Several farmers' lines are projected.

McLOUTH, KAN.—The H. D. Edmond Telephone Company operates "American" apparatus, has a 200-drop board and 125 subscribers with 173 miles of toll line and more projected. Rates of subscriptions or toll service are $1 and $2 in the town; $25 for the first year and $1 per month after, in the country.

ANTHONY, KAN.—The Southwestern Telephone Company has just finished rebuilding an exchange at Enid, Okla., at a cost of upwards of $50,000. It has exchanges at Harper, Anthony and Attica, Kan., at Carmen, Cherokee, Alva and Enid, Okla., together with 300 miles of toll line connecting 35 cities and towns in Kansas and Oklahoma. These properties represent a cost value of $110,000.

WOLFSVILLE, MD.—This local company was built to secure connection with the Frederick County Telegraph and Telephone Company with exchange at Frederick, Md., into whose hands it will eventually pass.

STREET, MD.—The Highland Telephone Company operates two switchboards of 100 and 50 drops respectively. It supplies service to 200 subscribers and has 50 miles of toll line. Its charges are $15 for dwellings, $18 business houses.

TEPEHUACAN, MEXICO.—A telephone line is to be constructed between this place and Tamala. The state government will give aid to the enterprise.

HERMOSILLO, MEXICO.—Senor Monteverde, of this place, has obtained a concession for establishing a complete telephone system here. He is negotiating with an American company to take hold of the enterprise.

FOWLERVILLE, MICH.—This is a mutual system and is intended to cover the county. The exchange has a 100-drop board and 25 subscribers.

BYRON, MINN.—The Jumbro Valley Telephone Company operates a 100-drop board, has 70 subscribers and 40 miles of toll line, with several more in contemplation. There is a good independent connection here, with many cities and a fine scope for country work.

HATTIESBURG, MISS.—The Peoples' Telephone Company operates a 600-drop board, has 325 subscribers and 125 miles of toll line. Its rate is 25 cents for three minutes.

ST. LOUIS, MO.—The Blythedale Telephone Company has been incorporated by O. F. Hutton and others. The capital stock is $5,000.

PLATTSBURG, MO.—The Plattsburg Telephone Company operates a 200-drop board, has 250 subscribers and 200 miles of toll line. Rates are $1.50 and $2. A large increase is projected. The common return system is now being put in.

BEAVER CROSSING, NEB.—The Beaver Crossing Telephone Company is about to commence operations and will operate Ericsson apparatus. There is a 100-drop board, and 50 to 75 miles of toll line are to be completed. Rates will be $1, $1.25 and $1.50.

AURORA, NEB.—The Hamilton County Farmers' Telephone Association operates two drop boards of 100 each and two of 10 each. It has 156 subscribers. There are 52 miles of toll line at 50c. per month, and 47 more in prospect. This association was started by three men for their own convenience, and lines were asked for faster than they could be supplied. It is a grounded system, but is to be changed to metallic very soon. It is now incorporated with $10,000 capital.

PRINCETON, N. J.—The Automatic Telephone Exchange Company operates 125 switches and has 105 subscribers at $25 per annum.

POINT PLEASANT, N. J.—The Seashore Telephone Company uses Phœnix and Kellogg apparatus, a 140-drop board and has 145 subscribers. Business rates are $20; residence, $15.

WATERTOWN, N. Y.—The Citizens' Telephone Company has a board of 600-drop capacity and 560 subscribers, with 9 miles of toll line.

DUNDEE, N. Y.—The Dundee Telephone & Telegraph Company has been incorporated by C. J. Watson and others, with a capital stock of $2,500.

WESTFIELD, N. Y.—The Westfield Telephone Company operates a 200-drop board, has 298 subscribers and 84 miles of toll line. Extensions are to be built.

COBLESKILL, N. Y.—The Cobleskill Telephone Company uses "Western" apparatus has a 100-drop switchboard capacity and 120 subscribers. The rates are $15, $12.50 and $10 per year.

COBLESKILL, N. Y.—The Cobleskill and Sharon Telephone Company uses a 25-drop board of Western construction. It has 25 subscribers and 37 miles of toll line. The subscription rate is $15.

CATTARAUGUS, N. Y.—The Pioneer Telephone Company has about 150 subscribers at $9 for residences and $12 for business houses. It has 10 miles of toll line and is increasing business rapidly.

POTSDAM, N. Y.—The Racket River Telephone Company operates a 200-drop board and is about to put in another. It has 225 subscribers and 200 miles of toll line. Rates are $12 and $15 per year.

HUDSON, N. Y.—The Commercial Telephone Company and the Columbia Telephone Company, of Hudson, have been merged, the capital being $50,000. The directors are R. G. Foster, Benjamin F. Case and E. Charles Getty.

COMSTOCK, N. Y.—The Comstock Telephone Company connects at North Granville with the Granville Telephone Company. This again gives connections with other lines to Albany on the South and Port Henry on the north.

SYRACUSE, N. Y.—The Columbia Long Distance Telephone Company has 70 subscribers and 125 miles of toll line. Rates vary according to distance. Lines have been completed from Syracuse to Elbridge; and Syracuse to Phœnicia.

VICTOR, N. Y.—The Peoples' Telephone Company operates Stromberg-Carlson apparatus, and an 80-drop board with 36 subscribers. It has 140 miles of toll line and five exchanges—at Holcomb, Vincent, Victor, Honeye and Naples. The company will build rural lines within the field now covered by its toll lines.

SHERMAN, N. Y.—The Sherman Telephone Company operates a Kellogg 200-drop board and has 350 subscribers with orders now to put in another hundred. There are 60 miles of toll line and 20 more projected. Rates of subscription are $9, $12 and $24.

SYRACUSE, N. Y.—The Syracuse Telephone Company uses central energy apparatus. It operates a 2,400-drop board and has 2,300 subscribers. A general extension of the system is projected, including subway lines, new building and exchange equipment. Its rates are: business, $36; residence, $24. Party lines, business, $30; residence, $18. A toll line is operated in connection with the Columbia Long Distance Company.

GREENSBORO, N. C.—The sale of the Greensboro Telephone Exchange to the Southern Bell Telephone Company has been consummated and the latter company has taken charge. The consideration was $70,000. The deal includes the property of the American Telephone & Telegraph Company, which has been preparing to build an exchange to compete with the Greensboro exchange.

WILLISTON, N. DAK.—The Williston Telephone Company has 160 drop board capacity and 90 subscribers. There are 50 miles of toll line at 1c. per mile and 50 more are projected.

POINT ROCK, OHIO.—The Point Rock and Wilkesville Independent Telephone Company has 169 subscribers and 69½ miles of rural line.

NORTH RIDGEVILLE, OHIO.—The North Ridgeville Telephone Company operates a 50-drop board with 50 subscribers. Toll rates are $18 per annum.

MT. VERNON, OHIO.—The Mt. Vernon Telephone Company, which is incorporated under the laws of West Virginia, has increased its capital stock to $100,000.

SPENCERVILLE, OHIO.—The Spencerville Telephone Company has a 300-drop board and 350 subscribers and over 70 miles of country line. A large increase is projected.

CONNEAUT, OHIO.—The Conneaut Telephone Company is planning to enlarge its switchboard in order to take care of a large number of subscribers now on the waiting list.

DAYTON, OHIO.—The Montgomery County Telephone Company has been incorporated with $200,000, by L. Rauh, H. C. Kiefaber, J. T. Barlow, Edward C. Canby and J. D. Artz.

HARRISON, OHIO.—The Harrison Telephone Company has signed a contract with the City & Suburban Company (Bell) whereby it will install a new switchboard and use Bell instruments.

LONDON, OHIO.—The London Home Telephone Company has increased its capital stock from $125,000 to $200,000 and will make improvements. W. M. Jones is president, and W. J. Meech, secretary.

BURTON, OHIO.—The Burton Telephone Company has increased its capital stock and is planning to install a 1000-line switchboard. The system is being extended throughout the surrounding farming district. A. M. Baird is manager of the company.

PERRYSVILLE, OHIO.—The Farmers Telephone Company, of Perrysville, and the Monroe Telephone Company, of Lucas, have arranged for an interchange of business and propose to extend their systems throughout the entire farming district of Lucas County.

BELLEFONTAINE, OHIO.—The United Telephone Company operates a switchboard of 800-drop capacity and has 750 subscribers. It also owns 12 other smaller exchanges with 1,100 telephones. There are 500 miles of toll line at the following rates: $2.50 private line, business; $2 two party line, business; $1.50, $1.25 and $1. for one, two and four party residences respectively.

GARBER, OKLA.—The Garber Telephone Company has been incorporated with a capital stock of $5,000. Mr. B. A. Garber is interested.

GRAND, OKLA.—The Grand Telephone Company was organized in February for the purpose of putting the town in connection with the railroad at Gaye. It contemplates an extension to Cheyenne. It has 14 subscribers and 26 miles of toll line charging 25c. per message.

OTTAWA, ONT.—A bill is now before the Dominion Parliament to incorporate the Canadian Telephone & Telegraph Company, with headquarters at Ottawa, and a capital stock of $1,000,000. The promoters, who are nearly all Americans, are George I. Stegmater and Christopher J. Stegmater, of Wilkesbarre; Frederick Warnke, Jacob W. Warnke, Charles Robinson, John A. Mears, James R. Mears and Walter L. Schlager, of Scranton; Francis J. Leonard, of Philadelphia, and Harry Bryden, of Pittston. The Canadians are William H. McCormick, John Culbert, M. P., Rufus H. Pope, M. P., W. F. McCreary, M. P., and some others. The company asks power to construct or buy telephone and telegraph lines anywhere in Canada, by either overhead wires or cables underground and to connect its system with existing telephone, telegraph and cable lines. Provision is made for a government control of tolls. The company seeks power, also to erect works for the generation of electric power. At least three directors are required to be residents of Canada.

McKEESPORT, PA.—The Federal Telephone Company will soon begin to place its wires underground in this place.

WALHALLA, S. C.—The Oconee Telephone Company has a 100-drop board here, 70 at Seneca and 50 at Westminster. There are 285 subscribers and 70 miles of toll line, to which 50 more will soon be added. The company is now rebuilding all offices and making every circuit metallic. Fifty more telephones are expected within the next twelve months.

ALSEN, S. DAK.—The Alsen, Beresford & Emmett Telephone Company has 25 miles of toll line and intends building a party line.

MEMPHIS, TENN.—It is reported that the Home Telephone Company, of Memphis, will build a line from Jackson to Humboldt, Tenn.

CHATTANOOGA, TENN.—The Hamilton Telephone Company has been incorporated with a capital stock of $5,000. Mr. Z. C. Patton is one of the directors.

LIVINGSTON, TEX.—The Livingston Telephone Company has been incorporated with a capital stock of $2,000. Mr. L. F. Gerlach is one of the directors.

WICHITA FALLS, TEX.—The Texas Telephone Company has 350 miles of toll lines and three exchanges. The lines reach points in Texas, Oklahoma and Indian Territory.

AMARILLO, TEX.—The Amarillo Telephone Company uses wire fences as line to a distance of 50 miles for ranches, of which 25 will be connected. It has a Eureka 300-drop board, 310 subscribers, 200 miles of toll line at $1.50 for residences and $3 for business houses, and intends putting in another 100-drop board and 100 miles of toll line.

SALT LAKE CITY, UTAH.—The Utah Independent Telephone Company has a 12,000-drop board with 4,000 subscribers and 400 miles of toll line. Mr. F. B. Hall is chief engineer. The company purposes to cover Utah, Idaho and Montana, work to that end already making rapid progress.

GRANTSBURG, WIS.—The Consolidated Telephone Company will build a line to Shell Lake, Spooner and Superior.

ASHLAND, WIS.—The North Wisconsin Toll Line Company, of this city, has been incorporated with a capital stock of $30,000. Mr. C. F. Latimer is one of the incorporators.

ELECTRIC LIGHT AND POWER.

MONTGOMERY, ALA.—The Citizens' Light, Heat & Power Company has been organized, with a capital of $30,000, by Alex. Rice, C. L. Ruth and others.

HUNTSVILLE, ALA.—The Huntsville Electric Railway, Light & Power Company has secured the contract for lighting the streets for five years at $75 per light per year.

PRESCOTT, ARIZ.—Engineer J. G. Girard writes that it is proposed to construct an electric power plant in Cataract Creek for operating 50 miles of railroad; probable cost of work, $2,000,000.

CHICO, CAL.—The Butte County Power, Light & Water Company has been incorporated, with principal office at Chico; capital, $300,000. W. P. Lynch, of Cherokee, and A. F. Jones, of Oroville, are among the directors.

PUEBLO, COL.—The contract for erecting and installing an electric light plant and wiring system for the lunatic asylum buildings has been awarded to Skinner & Sethman, of Denver, for $12,850.

WILLIAMANTIC, CONN.—The Willimantic Gas & Electric Light Company informs us through Mr. Jackman, superintendent, that its plant has just been thoroughly remodeled with excellent results. There are 92 1,000-cp arcs and 1,000 16-cp incandescent lights. Mr. J. F. Church is president.

AUGUSTA, GA.—The Augusta Railway & Electric Company will extend its lighting system to Summerville.

COLUMBUS, GA.—The city of Columbus has tabled an ordinance requiring all wires in the business district to go underground. Both telephone companies are voluntarily placing their wires underground in the business section.

HIGHFALLS, GA.—The Towaliga Falls Power Company, with Seaton Grantland, W. J. Kincaid, Jas. M. Brawner, and others, as directors, has applied for a charter. The company proposes converting the water power at Highfalls into electric power for transmission to Griffin and other places.

KEMPTON, IND.—A new electric lighting plant will be installed in this city this year.

KNIGHTSTOWN, IND.—The Knightstown Water & Light plant (municipal) operates 25 enclosed arcs and 1,000 16-cp incandescents.

BEDFORD, IND.—The Bedford Light, Heat & Power Company has issued preferred stock to the amount of $31,000. A. C. Vorris is president of the company.

FAIRMOUNT, IND.—Jacob Briles, City Clerk and Treasurer, writes that there is a movement on foot here to put in an electric light plant by stock subscription.

BEDFORD, IND.—The Bedford Electric Light & Power Company has issued $31,000 in preferred stock. The company contemplates extensive improvements and the installation of modern machinery.

FT. WAYNE, IND.—The Ft. Wayne Electric Light & Power Company, which does all the commercial and municipal electric lighting in this city, has purchased the rights and privileges of the General Heating Company, of Ft. Wayne, which is capitalized at $500,000.

INDIANAPOLIS, IND.—The specifications for the new electric lighting contract for this city are completed and ready for advertisement. A franchise ordinance will be drawn for commercial lighting to accompany the city contract. This will give an outside bidder all the advantages of a bidder already having a franchise for commercial lighting in the city. There is much interest manifest in this contract. This city is now paying $85 against $75 at Terre Haute, $68.58 at Dayton, O., and $84 at Louisville.

MOULTON, IA.—The La Plata Electric Light Company, of La Plata, Mo., will construct an electric light plant at Moulton.

GLADSTONE, KY.—R. S. Weitzell, manager Gladstone Coal & Coke Company, writes that the company contemplates putting in an electric power plant to mine and haul coal, etc., and probably to light its office and store building.

NEW ROADS, LA.—The New Roads Electric Light & Power Company, Ltd., of New Roads, La., is in the market for all machinery and material for an electric light plant of 2,000 16-cp lamp capacity. For particulars, plans and specifications, address W. H. Fleming, 327 Hennen Bldg., New Orleans.

NEW ORLEANS, LA.—The New Orleans Railways Company and the Colonial Electrical Corporation have submitted proposals for electric lighting and power work. The former proposes to furnish and maintain 409 arc lamps in the underground district for $90 per annum and 2,218 lamps in the overhead district for $77.50 per annum (these prices being in accordance with a schedule depending on the number of lamps used), making a total of $208,705. It figures that the cost to the city, if operating from a municipal plant, would be $55 per lamp, and allowing $1,100,000 for the cost of such a plant and 5 per cent. for interest charges and 7 per cent. for depreciation, the cost for 2,627 lamps would be $277,648, $68,943 more per year than the railway proposition. Other proposals were made comprehending a less number of lamps or the maintaining of some at present in use. The latter's proposition covered a lighting and power plant at a cost of $1,480,615 if cypress poles are used, and $1,395,154 if pine poles are used, the power house to cost $105,760 and the equipment, $405,800.

BALTIMORE, MD.—General superintendent of lighting McCuen in his annual report recommends the construction of a municipal electric light plant.

MANSFIELD, MASS.—The town of Mansfield has decided to install its own electric light plant at a cost not to exceed $40,000. Bonds will soon be put on sale for payment of this work, running 30 years and bearing four per cent. interest.

EVERETT, MASS.—The contract for lighting the city by electricity has been awarded to the Malden Electric Company at $90 per year for 2,000-cp arcs and $15.50 per year for 25-cp incandescents; total amount of contract, $17,038.

TECOLOTLAN, MEXICO.—A new electric light plant has just been installed at this place.

SAN ANDRES CHALCHICOMULA, MEXICO.—Fogarty & Dickenson, of San Luis Potosi, Mexico, will install an electric light plant here.

SAYULA, MEXICO.—A new electric light plant is to be installed here. The state legislature has exempted the plant from the payment of taxes.

CUERNAVACA, MEXICO.—The electric light plant at this place has just been inaugurated, the ceremony attending the event being conducted by the Governor of the State.

TAMAZULA, MEXICO.—Fogarty & Dickenson, of San Luis Potosi, Mexico, have obtained the contract and acquired the necessary rights, etc., from the federal and municipal government for the installation of an electric light plant here.

CITY OF MEXICO, MEXICO.—The details of the concession granted by the Mexican Government to the Mexican Light & Power Company for the establishment of immense electric generating and transmission plants at the falls of the Tenango, Necaxa and Catepuxtla rivers, situated about eighty miles from this city, have just been arranged and official publication of the concession made. According to the terms under which the concession is granted, the company agrees, among other things, to establish within four years a plant sufficient to produce 15,000 horse-power, and within ten years a plant with capacity to generate 30,000 horse-power; also the electric apparatus and transmission lines necessary to convey the electric energy to this city and such other cities and towns as the company may desire. All the necessary machinery, etc., for the construction and installation of the enterprise shall be admitted into Mexico free of duty. During five years from the date of the concession, all the capital invested in the enterprise, and all the bonds and obligations of the company shall be exempt from all taxation, except the stamp tax. The company has deposited $50,000 in bonds of the national consolidated debt in the National Bank of Mexico as a guarantee that the terms of the concession will be complied with.

DETROIT, MICH.—The Edison Illuminating Company has, it is reported, purchased a site for a sub-station.

MADISON, MINN.—The City Council is considering improvements to the electric light plant.

EXCELSIOR, MINN.—John Lind, of Minneapolis, has secured a franchise for an electric light plant. It will also be extended to Tonka Bay and Cottagewood.

WINONA, MINN.—The Winona Railway & Light Company has secured the contract for lighting the city for ten years with enclosed arc lights at $68 per lamp per year.

SAUK RAPIDS, MINN.—The Watab Rapids Power Company is reported incorporated to dam the Mississippi River and develop electrical power. A. J. Gillette is president.

VICKSBURG, MISS.—It is stated that the Vicksburg Railway & Light Company will expend about $200,000 in improvements and extensions.

YAZOO CITY, MISS.—Bids will be received by the mayor and Board of Aldermen until July 13 for building a 450-hp Scotch marine or water-tube boiler, 200 and 100-kw polyphase alternators, direct-connected to compound condensing engines, switchboard, arc lamps, transformers and pole line supplies. E. J. Poursine is City Clerk; Kirkpatrick & Johnson are the engineers, Jackson, Mich.

CONCORD, N. H.—Holbrook, Cabot & Rollins, of Boston, Mass., have secured the contract to erect a granite dam at Garvin's Falls, on the Merrimac River, in Concord. It will be about 400 ft. in length. The Manchester Traction Company is the owner of the property.

BUFFALO, N. Y.—The Special Committee of the Board of Councilmen has reported, recommending the establishment of a municipal electric lighting plant.

ITHACA, N. Y.—The Ithaca Electric Light & Power Company, of Ithaca, has been incorporated; capital, $500,000. Directors: E. C. Stewart, H. L. Hinckley and D. W. Burdick, of Ithaca.

PORT LEYDEN, N. Y.—The citizens have voted to contract for lighting the streets by electricity for a term of five years. A company has been formed and the power plant will be located on Moose River a few miles from this place. The company will light both Port Leyden and Lyon Falls.

NEW PALTZ, N. Y.—The Electric Light Company of New Paltz was organized in 1902, with $20,000 capital stock and $10,000 bonds; G. E. Johnston is president. There are 600 commercial and 152 street series, 20-cp incandescent lamps. The company has just contracted for a Stanley 1200-volt generator.

SEA CLIFF, N. Y.—The Nassau Light & Power Company, of Roslyn, Long Island, has bought outright the Franklin Electric Illuminating Company, of Sea Cliff and Glen Cove, and will hereafter conduct the business of that company from its Roslyn office as a separate organization. Mr. H. C. Wybro has been elected president and Mr. W. J. Wilson, secretary and treasurer.

LIDGERWOOD, N. D.—The City Council has granted Ralph Maxwell a franchise for an electric light plant.

MOOSOMIN, ASSA., N. W. TER.—It is reported that this town invites correspondence and propositions for a lighting system for a town of 1,200. John Smithers is secretary.

COLUMBUS, OHIO.—The city has taken out a permit for the erection of its new $65,000 municpal lighting plant.

STRUTHERS, OHIO.—The council has placed a contract with the Consolidated Gas & Light Company for 12 arc lamps at $66 per year.

COLUMBUS, OHIO.—The fund for municipal lighting has been expended and there is danger that the lighting plant will have to be closed down.

XENIA, OHIO.—The Xenia Heat, Light & Power Company, capital $1,000, has been incorporated by M. R. Snodgrass, H. N. Schlessinger, F. M. Hagan and A. H. Kunkle.

WARREN, ONT.—It is reported that bonds have been voted to establish a light and water plant.

OTTAWA, ONT.—The Ottawa Electric Company has obtained from the Dominion parliament authority to increase its borrowing powers to the extent of $1,000,000. The existing bonding power, granted in 1893, is $500,000. There are $300,000 of outstanding liabilities which the company proposes to meet out of the half-million it is now getting power to borrow; the balance will be kept in the treasury until needed.

FENELON FALLS, ONT.—The town of Fenelon Falls is embarking upon a curious experiment in municipal ownership. A bylaw has been carried to raise $75,000 and with this money the town will acquire not only a water-power and electric light, but also a roller flour mill. The firm which has been running the mill controlled 500 horse-power. It has been bought out for $35,000, and the town will build a power station at an estimated cost of $25,000.

BAKER CITY, ORE.—Fire completely destroyed the plant of the Gas and Electric Company. The loss was approximately $30,000. The company announces that a new plant will be installed at an early date.

MIFFLINSBURG, PA.—It is stated that bids will be received about July 7 by the Burgess and President of Council for constructing an electric light plant. T. M. Getgen is Town Clerk.

MASONTOWN, PA.—The Masontown Light, Heat & Power Company has organized by electing J. V. Hoover, president; W. H. Crawford, secretary. The capital stock of the company is $25,000. Work will begin inside of 60 days.

SHERBROOKE, QUE.—The city of Sherbrooke proposes to purchase the electric plant of the Sherbrooke Heat, Light & Power Company. The valuation of the plant and water-power is placed by the city at $121,116, and the City Council decided to make an offer of $150,000 to the company for immediate possession, the difference of $29,000 being compensation for the unexpired portion of the contract with the city. It is not expected that the company will accept the offer as it values its plant at $190,000, and if it does not, the city will then develop its own electric power.

GEORGETOWN, TEX.—It is stated that about $10,000 will be expended in improving the plant of the Georgetown Water & Electric Light Company.

MARLIN, TEX.—It is reported that Capt. J. A. Martin and B. C. Nettles, of Marlin, have employed Prof. T. U. Taylor to visit the falls of Brazos River, near Marlin, and make an examination and give an opinion on the practicability of developing the power and an estimate of the power that could be obtained. The object is to convert the power into electricity to be conveyed to Marlin.

RICHMOND, VA.—Samuel Cohen and others have petitioned for a franchise to erect an independent electric lighting plant in Richmond.

RUTLAND, VT.—The Rutland Power Company, of Rutland, has been incorporated; capital, $10,000. Incorporators: Wallace W. Nichols, Newman K. Chaffee and others.

NORFOLK, VA.—Ladshaw and Ladshaw, of Spartansburg, S. C., have the contract for developing 20,000 horse-power on Roanoke River near Weldon, N. C., for electric transmission to Norfolk, 90 miles distant.

THE ELECTRIC RAILWAY.

LITTLE ROCK, ARK.—Articles of incorporation of the White River & Mountain Home Railway Company have been filed with the Secretary of State, and the charter granted. The capital stock is $150,000. The incorporators are C. S. Claybrook, of St. Louis; T. N. Chenowith, R. S. Wilson, George W. Keene, W. Howard Brown, James Burke, P. E. Bratton and Samuel Wilken, of Mountain Home; S. E. Denton, H. C. Browning, of Gassville.

TRINIDAD, COL.—The City Council has granted a petition for a franchise for the construction of a street railway and lighting plant presented by Frank P. Read, of St. Louis, Mo.

NORWICH, CONN.—The Norwich Street Railway Company increased its capital stock to $350,000. The additional capital is to enable the company to carry out its plans of expansion.

ELLINGTON, CONN.—The Rockville, Broad Brook & East Windsor Street Railway Company has organized as follows: Frank Grant, president; H. C. Wells, vice-president; C. E. Harwood, secretary and treasurer.

WINDSOR LOCKS, CONN.—The Windsor Locks & Rainbow Street Railway Company has been authorized to increase its capital stock from $100,000 to $300,000. The company will build a continuous trolley line between Hartford and Springfield.

WASHINGTON, D. C.—The Old Dominion and Great Falls Electric Railway Company has purchased a site for its power house on the Virginia side of the Potomac River, just below the falls.

DECATUR, ILL.—Articles of incorporation have been filed by the Decatur, Springfield & St. Louis Railway Company, with a nominal capital stock of $50,000.

CHICAGO, ILL.—The Freeport Electric Company has changed its name to the Freeport Railway, Light & Power Company. The capital stock has been increased from $5,000 to $350,000.

CANTON, ILL.—Articles of incorporation have been filed by the Fulton County Electric Railway Company with a capital stock of $10,000. The incorporators are James A. W. Lawrence, Henry H. Fuller and Herbert J. Shannon.

MORRISON, ILL.—The Morrison and Denrock Electric Railway Company, with principal office at Morrison, Ill., has filed articles of incorporation. The incorporators and first board of directors are George Milne, Aaron D. Hill, Charles G. Mackin, Arthur M. Kidd, and Paul M. Bent, all of Morrison.

SPRINGFIELD, ILL.—The Springfield & Northern Railway Company, with principal office at Chicago, has filed articles of incorporation. The capital stock is $25,000. The incorporators and first board of directors are Gustave F. Fisher, Edwin J. Mosser, William C. Rigby, Benjamin F. Ninde and John M. Bryan, all of Chicago.

SPRINGFIELD, ILL.—The Southern Illinois Electric Railway has been incorporated with a capital stock of $50,000, with principal offices at Mount Vernon. The incorporators and first board of directors are John R. Piercy, George F. M. Ward, Samuel Casey, Louis G. Pavey, Samuel T. Maxey and Albert N. Johnson, all of Mount Vernon.

SPRINGFIELD, ILL.—The Jacksonville & Springfield Traction Company, with principal office at Springfield, has filed articles of incorporation. The capital stock is $2,500. The incorporators and first board of directors are Y. Alexander, Lexington, Ky.; W. S. Kelly, Georgetown, Ky.; James Y. Kelly, Jr., W. St. James Wines and Dick Steele, of Springfield, Ill.

DIXON, ILL.—The DeKalb and Southwestern Electric Railway Company has been incorporated, with principal offices at Dixon; capital stock, $5,000. The incorporators and first board of directors are E. L. Titus and I. R. Titus, of Steward, Ill.; S. D. Frost, Amboy, Ill.; Sagerman L. Shaw, Lee Center, Ill.; George H. T. Shaw, Dixon, Ill. The power house is to be located at Rock Falls.

SPRINGFIELD, ILL.—The Springfield, Moweaqua, Sullivan and Mattoon Railroad Company, has been incorporated with a capital stock of $25,000, with principal offices at Sullivan. The incorporators and first board of directors are Joseph B. Titus, John R. Pogue and Samuel B. Wright, Jr., of Sullivan; Isaac B. Craig, Mattoon; Ira T. Baird, of Prairie Home, Ill.; James E. Gregory and Valentine Snider, of Maweaqua, and James W. Jefferson, of Springfield.

SPRINGFIELD, ILL.—The Springfield Railway & Light Company has been organized by King, Hodenpyl & Co., of Chicago, and E. W. Clark & Co., of Philadelphia. The company has taken over the control of the following public-service companies of Springfield, Ill.; Springfield Consolidated Railway, Springfield Gas Light Company, Springfield Electric Light & Power Company, Capital Electric Company, People's Hot Water Heating & Electric Company. The new company is authorized to issue $3,000,000 twenty-five-year 5 per cent. gold bonds and $3,000,000 stock. Many improvements are proposed. The officers are Anton G. Hodenpyl, president; C. M. Clark, Philadelphia, vice-president; G. L. Estabrook, Philadelphia, secretary and treasurer.

INDIANAPOLIS, IND.—Two interurban sleeping cars, each containing twenty berths, have been ordered and will be put into service between this city and Dayton, Ohio. It is stated that these cars will be the first of their kind ever built in this country, and will cost $38,000. Each compartment will be lighted and heated by electricity, both of which will be under the control of the occupant. It is stated that a charge of $2 will be made for each berth in a compartment.

INDIANAPOLIS, IND.—The Indiana Union Traction Company has been organized and incorporated. This organization involves the consolidation of the street railway companies in all the cities and towns of the north-eastern part of the state through which the Union Traction Company's interurban lines now run or will be run. The capital stock is $5,000,000. Horace C. Stillwell is president of the new company and the board of directors are all directors or stockholders in the Union Traction Company.

TERRE HAUTE, IND.—The Terre Haute Electric Traction Company has incorporated with a capital stock of $3,000,000, to take over the property of the Terre Haute Electric Company, capitalized at $1,000,000. The property is owned by Stone & Webster, of Boston, who take this course to secure the benefits of laws enacted in recent years favorable to traction companies. The Terre Haute Electric Company owns the only electric lighting and power station in Terre Haute. It also has a power station at Brazil and is building interurban roads to Paris, Ill., and to Clinton. Of the stock in the new company $1,000,000 is preferred, while $2,000,000 is common.

DES MOINES, IA.—M. E. Springer, of Des Moines, is promoting a company to build an electric railway from Albia to Buxton, Hiteman, Hocking, Hilton and Hynes.

CEDAR RAPIDS, IA.—The Cedar Rapids and Iowa City Railway & Light Company has been organized for the purpose of constructing an interurban line from Cedar Rapids to Iowa City, a distance of 28 miles. The capital stock of the new company is fixed at $2,000,000. The company will succeed the Cedar Rapids, Iowa City & Southern Railway, which was incorporated in December, 1901, with a capital stock of $100,000. The officers of the new company are: Stephen J. Dows, president; J. H. Smith, vice-president; E. E. Pinney, treasurer and secretary.

WICHITA, KAN.—The State Charter Board has just issued a charter to the Arkansas Valley Interurban Company, with headquarters in Wichita. The capital stock is $1,000,000 fully subscribed. The company is to build and operate an electric railway from Wichita to Winfield, Wellington, Arkansas City, and furnish light and power along the line. It will be operated by water-power taken from the Arkansas River. Z. T. Daniel is chief engineer of the company.

MT. OLIVET, KY.—The Maysville & Mt. Olivet Traction Company has been organized with J. W. Duly, president; E. Kenton, vice-president, and George W. Dye, secretary.

LOUISVILLE, KY.—Plans are being discussed for building an electric railway from Louisville to New Albany, in West Baden and Salem. Judge J. T. Buskirk is interested.

NORTHAMPTON, MASS.—The Greenfield, Deerfield & Northampton Street Railway Company has petitioned the Railroad Commissioners for authority to increase its capital stock $30,000. The Greenfield & Deerfield Road has also presented a similar petition.

HURON, MICH.—The Huron & Michigan Railway Company has been incorporated with a capital stock of $2,300,000. The directors of the company are Leslie J. Hanes, Henry W. Lake, Helene DuBois, Howard B. Bloomer and Arthur D. Prosser.

MT. AYR, MO.—Plans are being discussed for the construction of an electric railway from Mt. Ayr to Hatfield, Mo., 18 miles, and thence southeast about 60 miles to Pattonsburg, Mo. A. M. Pryor, of Leon, is interested.

EXETER, N. H.—The Hampstead & Haverhill Street Railway, chartered by the last legislature, with an authorized capital of $75,000, has been organized at Exeter with the following directors: William A. Emerson, president, and George S. Palmer, of Hampstead; Edson E. Peaslee, treasurer, of Plaistow; George A. Sawyer and Herbert N. Sawyer, of Atkinson.

NEWARK, N. J.—The offices of the Public Service Corporation of New Jersey, which has taken over the electric railway and lighting interests of Northern New Jersey are Thomas N. McCarter, president; Randal Morgan, Anthony R. Kuser and Albert B. Carlton, vice-presidents; Frederick Evans, secretary; James P. Dusenberry, treasurer; Percy S. Young, comptroller; Frank Bergen, general counsel. The business of the corporation is to be divided into three branches, viz.: Transportation, with Walter W. Wheatley, formerly of the Brooklyn Rapid Transit Company, as general manager; electric light and power, with Dudley Farrand, of the United Electric Company, as general manager, and gas, with H. D. Whitcomb, of the Essex & Hudson Gas Company, as general manager. The Executive Committee will consist of Thomas N. McCarter, Randal Morgan, Anthony R. Kuser, Walton Clark, general superintendent of the United Gas Improvement Company; Lewis Lillie, treasurer of the same company; Uzal H. McCarter, Thomas C. Barr and John I. Waterbury.

OGDENSBURG, N. Y.—A deal has been completed for the purchase of the Keesville, Ausable Chasm and Lake Champlain Railroad by a New York syndicate. John P. Powers, of New York, is at the head of the syndicate. The company proposes changing the Keeseville Railroad from a steam to an electric road and to extend the line through Keeseville, its present terminus, to Lake Placid, thus opening it up to the Adirondacks.

CLEVELAND, OHIO.—The Cleveland, Ravenna & Southern Railway Co. has been incorporated with a nominal capital of $1,000 to build an electric line from Cleveland to New Baltimore. The incorporators are F. E. Dellenbaugh, C. A. Bingham, J. E. Rowland, C. A. Saunders and J. P. Rauch.

DAYTON, OHIO.—The option held on the Dayton & Troy traction line by the Cincinnati, Dayton & Toledo has expired without having been taken advantage of. This development is taken as an indication that the cross-state system of traction lines under the direction of the Widener-Elkins syndicate has been indefinitely deferred.

TOLEDO, OHIO.—The Ohio & Michigan Traction Company has been incorporated at Monroe, Mich., with $1,650,000 capital stock. The company proposes to build from Toledo to Ann Arbor, Mich. Officers have been elected as follows: J. H. Class, president; H. C. Stahl, vice-president; L. L. H. Austin, secretary and general manager; J. W. Pero, treasurer.

AKRON, OHIO.—The Akron-Alliance Connecting Railway Company has filed a $2,000,000 mortgage in favor of the Eastern Trust Company of New York. The mortgage secures the issuance of $2,000,000 in bonds. The company will build an electric railway from Alliance to Akron, 30 miles, with a probable extension from Alliance to East Liverpool, 43 miles.

UNIONTOWN, PA.—The West Masontown Street Railway Company recently organized by electing J. V. Hoover president and W. I. Crawford, secretary.

NEW INDUSTRIAL COMPANIES.

THE NATIONAL BATTERY FAN COMPANY has been incorporated at Washington, D. C., by George C. Ayers, Charles E. Doyle, Hiram H. Hetzell, Walter Plumley and A. Plumley.

THE ZAHN ELECTRIC COMPANY, St. Louis, Mo., has filed articles of incorporation with a capital stock, paid up, of $5,000. The shareholders are W. G. Zahn, Wm. E. Howard and John B. Carroll.

THE WHITNEY ELECTRICAL INSTRUMENT COMPANY, of Esopus, Ulster County, N. Y., has been incorporated with a capital of $30,000. Directors: Julian S. Wooster and A. J. Ernest, New York, and B. M. Bliven, Brooklyn.

THE BURNSVILLE PROGRESSIVE COMPANY, of Burnsville, W. Va., has been incorporated to build, maintain and operate street car lines, waterworks and electric light plants. Capital, $25,000. The incorporators are Hugh Amos, D. C. Wellen, W. C. Hefner, W. W. T. Brosius and J. B. Hefner, all of Burnsville, W. Va.

LEGAL.

CAR HEATING.—The Gold Car Heating & Lighting Company has brought suit in the United States Circuit Court, northern district of Illinois, at Chicago, against Egbert H. Gold, for infringement of United States Letters Patent No. 388,772 for car heating apparatus.

IN FAVOR OF N. Y. METROPOLITAN.—Supreme Court Justice Scott, after hearing counsel on both sides sum up in the suit of Isidor Wormser, Jr., against the Metropolitan Street Railway Company to have its lease to the Interurban Street Railway Company set aside as illegal, dismissed Wormser's complaint, and gave judgment in favor of the defendant corporations. An appeal from this decision will be prepared and submitted to the Appellate Division early in the fall. In this case W. C. Whitney, H. H. Vreeland and other well-known public men gave interesting testimony.

HERZOG POLICE SIGNAL SYSTEM.—The Herzog Teleseme Company has filed with the County Clerk the papers in its suit against the city to recover $5,000,000 or compel the city to carry out a contract which the company alleges was entered into to fit the Police Department with a teleseme signal system. Summons in the action was served in April, 1894. The complaint says that the police board, in March, 1888, adopted a resolution to install the Herzog system, and the company submitted a proposal. That, the complaint says, constituted a contract.

VAN CHOATE VS. GENERAL ELECTRIC.—The interests associated with S. F. Van Choate, who was at the head of the Van Choate Electric Company when it failed several years ago, have entered suit in the United States Circuit Court against the General Electric Company for the alleged infringement of patents. The plaintiffs set the damages at $50,000,000 and the defendant's property is Essex County, Mass., has been attached. Mr. Van Choate's alleged patents are not familiar to the electrical public, but he claims large multipolar dynamos, the universal car controlled and apparently a few other things which would monopolize the art. Mr. Van Choate was formerly president of the Van Choate Electric Company, which built a plant at Foxboro and was capitalized under the laws of the State of Maine at $6,000,000, of which $600,000 was in preferred stock. The concern went into the hands of a receiver on Jan. 20, 1900, and the plant, the original cost of which was in the neighborhood of $200,000, was sold to satisfy a claim of the Attleboro Savings Bank for $58,000. There was a great deal of comment on the matter at the time in the New England papers, on account of the utter losses of the stockholders, many of whom were small, poor investors, attracted by the advertising of the concern.

CHICAGO STREET RAILWAYS.—In a hearing before Judge Grosscup, the following arguments on the validity of the street railway act of 1865, commonly known as the 99-year act, were made by counsel for the Chicago Union Traction Company: (1) The general assembly of Illinois had under the constitution of 1848 unlimited power to deal with the property right and franchises of municipal corporations, and therefore to make regulations regarding the street railways of Chicago as it in its discretion deemed most advisable for the public good. (2) Charges that the act was "bought and paid for"—secured by fraud and purchase of Illinois legislators—will not lie now, as the courts have held that the legislative acts of former generations cannot affect innocent holders of said interests to-day, provided the legislative acts involved were constitutional. (3) The act of 1865 was not in violation of the provisions of the constitution of 1848, which required that no private or local law which may be passed by the general assembly shall embrace more than one subject, and that subject shall be expressed in the title. (4) Long acquiesence in the validity of the act by the city and its representatives constitutes such laches as precludes them at this late date from objecting to the constitutionality of the act on the mere ground that its title is defective. (5) The acceptance by the companies of the ordinance of 1883 did not constitute a waiver by the companies of their rights under their original charters as amended by the act of 1865. As the hearing was of an informal nature and adopted by Judge Grosscup to obtain such information as may be needed properly to conserve the property intrusted to his care, the city was not represented by counsel or in an official way, and as a consequence its attitude toward the question was not presented.

OBITUARY.

MR. OTTO THORNERT.—A telegram from Philadelphia of June 19 says: "Otto Thornert, an electrical expert from Germany, was instantly killed to-day by touching a live wire while inspecting a new switchboard for the Germantown Electric Light Company. He had been in America only a few weeks. He was formerly assistant supervisor of the electric light system of Berlin, and was an authority on electrical construction. He was sent here as an agent of Siemens & Halske, of Berlin. Thornert was making the final adjustment of the switchboard when the accident occurred. Workmen in an adjoining room saw a flash, heard a heavy fall and later found Thornert lying twenty feet from the switchboard, dead. It is supposed that his hand came in contact with a switch, sending 2,500 volts through his body.

PERSONAL.

MR. BECKLES WILSON is writing for the Appleton Business Series a book entitled "The Story of Rapid Transit."

MR. C. O. BAKER, JR., the platinum merchant and expert, sailed this week for Europe on the American liner *Philadelphia*.

COL. R. C. CLOWRY, president of the Western Union Telegraph Company, has favored us with a personal denial of the Wall Street reports circulated last week that he intended to resign.

MR. CHARLES CLEGG, manager of the Compania de Ferrocarriles del Distrito Federal (the Mexican Electric Tramways, Limited) Mexico City, which system is to be extended, is now in New York at the Hotel Albemarle.

MR. CHARLES F. SCOTT, president of the American Institute of Electrical Engineers, made the address to the graduates at the commencement exercises last week of the Stevens Institute of Technology.

MR. MARSDEN J. PERRY, of the Narragansett Electric Light Co., Providence, R. I., has bought the valuable Sidney Rider Library of Rhode Island History for presentation to Brown University, of Providence.

MR. A. R. BLISS, the treasurer and general manager of the New England Motor Company, of Lowell, Mass., has been visiting New York and is making a long distance trip in the interests of that concern, including the South and West.

MR. and MRS. T. F. MANVILLE and family sailed on the *Kaiser Wilhelm II*, June 23, for London and the Continent, to be gone for two months. Mr. Manville goes to London on business in connection with the branch there of the H. W. Johns-Manville Co.

MR. HERBERT H. P. SEABROOK, of Seabrook Bros. & Co., of London, England, will be at the Astor House after July 8, with a view to securing the sole European agency for desirable American electrical specialties. He will probably stay several weeks in this country.

MESSRS. McKENZIE & MANN, the electric railway promoters of Toronto and Montreal, have secured control of the Kayak, Alaska, oil fields, giving the syndicate which they represent an advantage over the Standard Oil Company, which is sending a number of experts to the Kayak fields.

MR. H. T. HOCHHAUSEN has sold his business to the Metropolitan Engineering Company, of which he will have the entire management, and which will be located at 27 Sixth Ave., Brooklyn, N. Y., making a specialty of electric signs and lighting effects, the factory being especially equipped for such work.

MR. LEONARD ANDREWS, M. I. E. E., who has been spending some weeks in this country, sailed on Saturday by the *Etruria*, for London. He is now managing director of the Key Engineering Company, Ltd., and has made some important electrical engineering and commercial connections for it while in this country.

MR. HERBERT WILMERDING, secretary of the Philadelphia Fire Underwriters' Association, has been appointed by the National Fire Protection Association member of its delegation to the International Fire Prevention Congress in London, July 7 to 10, in place of Mr. W. H. Merrill, Jr., recently elected secretary of the association.

MR. HENRY W. POPE, lately acting general manager of the Bell Telephone Company at Buffalo, N. Y., has lost his wife who died at Buffalo on June 21. Mrs. Lucy D. Pope was well known in electrical circles and her husband has hearty sympathy from hosts of friends in this sad bereavement. The interment is at Great Barrington, Mass., in the Berkshires, where the Popes have so long resided.

MR. JOHN I. WATERBURY, president of the Manhattan Trust Company, of New York, and prominent in the Chamber of Commerce and other commercial organizations of New York, has been designated by the Secretary of State, on the nomination of Secretary Cortelyou, as a delegate on the part of the United States to the preliminary conference which is to be held in Berlin, Aug. 4, 1903, to formulate regulations governing the international control of wireless telegraphy.

COL. N. H. HEFT.—Col. N. H. Heft, chief of the electric department of the New Haven Railroad, and president of the Meriden and Stamford Street Railways, is to leave the New Haven road, according to an announcement made this week. He has been with the New Haven road for several years. His duities will be looked after by fourth vice-president, F. S. Curtis. He is well-known in the electrical field as a pioneer in third rail work on steam railroads, and as an active street railway manager.

BARON VON RHEINHABEN, the Prussian minister of Finance who recently came to the United States for the purpose of studying conditions on this side, sailed for Europe June 23 by the Hamberg-American liner *Kaiser Wilhelm II.* Moritz Baker, of H. H. Baker & Company, which firm represent the interests of the St. Louis Car Company in Germany, also left for Europe on the same steamer. Mr. Baker, who is a councillor of the German Empire, accompanied Baron von Rheimhaben on his visit here.

MR. ISAAC M. HUTCHISON, of Mexico City, is now in New York. His present visit has reference to the project of the Mexican Traction Company, of which he is president. The company has been granted an extension of time for the construction of a traction system to run from the Mexican capital to Chapultepec, a large fortress located two miles south-east of the city, and to Tacubaya, a small town situated six miles south-east of Mexico City. It will be recalled that Mr. Hutchison recently secured a concession for the construction of an extensive car-building plant in Mexico City. Both electric and steam cars will be built. Financial arrangements are now being completed, and contracts for equipment will be given out shortly after Mr. Hutchison's return to the Southern Republic. He represents the Mexican interests of several prominent United States manufacturing concerns, including the St. Louis Car Company, the American Steel Foundry Company, the American Locomotive Company, etc.

MR. H. H. VREELAND, who sails this week for Europe, and will appear by special request before the Royal Commission inquiring into the rapid transit necessities of London, was guest of honor on Monday night at a dinner given in the Hotel Savoy, when the officers and employees of the Interurban Street Railway Company presented him with a silver loving cup twenty-seven inches high. Two hundred men were chosen by the 8,000 employees to represent every department of the railroad, and all of them, conductors, inspectors and motormen, were united in their praise of President Vreeland. The platform at one end of the room where the dinner was served was tastefully decorated with miniature cable cars, and in front of every plate there was a figure of a motorman in full uniform. When H. D. Macdona, the attorney for the company, rose to present the cup, he was greeted with cheers. The applause was increased when Mr. Vreeland thanked them for the gift and he was frequently interrupted. He referred with pride to the friendly relations that had existed in all branches of the road during his ten years of service, and spoke of the large percentage of men that had remained in his employ from the first. He said he had no intention of resigning his position, despite contrary reports, and merely meant to take a few weeks' vacation.

MR. H. M. BYLLESBY, who established himself as a consulting electrical and mechanical engineer in Chicago about a year ago, has succeeded in building up a large and rapidly growing business, a considerable part of which consists in operating, reconstructing and improving local properties generally, along the lines followed by the United Gas Improvement Company with gas properties. He has associated with himself a staff of able operating men and engineers, and the most recent acquisition is Mr. O. E. Osthoff, who has been for a long while engineer of the Chicago office of the Electric Storage Battery Company. Mr. Osthoff changes over on the first of July, and he leaves the service of the Electric Storage Battery Company with the utmost regret and best wishes of that company, his relations with it being of the most cordial description. Mr. Byllesby is vice-president and engineer for the Zanesville, O., Railway, Light & Power Company; engineer for financial interests in the Columbus, O., Delaware & Marion Railway Company; president and general manager of the Mansfield, O., Railway, Light & Power Co.; Mansfield & Shelby Interurban Railway and Enid Electric & Gas Co.; vice-president and general manager of the Belleville, Ill., Gas & Electric Co., and the Centralia, Ill., Gas & Electric Co.; consulting engineer and member of executive committee Freeport, Ill., Railway, Light & Power Co.; director and engineer in charge of improvements, Hazleton & Wilkesbarre third rail system. Mr. Byllesby, as president and general manager of the Granite City & Venice Electric Power Distribution Co., has an interesting piece of work on hand in a plant which it has begun to build for the purpose of delivering current on a large scale in the Illinois district across the river from St. Louis, Mo.

EDUCATIONAL.

WESTERN UNIVERSITY OF PENNSYLVANIA.—Prof. S. M. Kintner reports that three men graduated in electrical engineering this year, as follows: S. R. Dodds, now with the Westinghouse Electric Mfg. Co.; Adam Stein, with Prof. Fessenden, on experimental wireless telegraph work at Old Point Comfort, Va.; and W. S. Worcester, with the National Tube Company, McKeesport, Pa. The university had a great demand for electrical graduates and was unable to supply it.

UNIVERSITY OF CHICAGO has as yet no school of technology and in consequence no electrical engineering department. A good deal of electrical work is carried on, but it is in the department of physics. Mr. Carl Kinsley informs us that the University hopes to establish an engineering school before long. The present scientific departments, magnificently equipped as they are, will in conjunction with the engineering school, be enabled to carry on engineering work of the most advanced character.

UNIVERSITY OF MINNESOTA.—Prof. Geo. D. Shepardson, electrical engineering department of the University of Minnesota, reports that as has been the case for several years past, there were more positions offering than graduates. All of the graduating class have had choice of several positions, and as many of the juniors as cared to work have secured positions for the summer, mostly in construction work. So far as located, the seniors are placed as follows: L. G. Rask and I. A. Rosok with the General Electric Company at Schenectady. L. R. Laird, L. W. Miller and M. L. Page with the Western Electric Company at Chicago. B. Dibble with Chief Engineer of Louisiana Purchase Exposition at St. Louis. J. H. Schumacher with W. I. Gray & Co., Contracting Engineers at Minneapolis. J. C. Vincent with Twin City Rapid Transit Company, at Minneapolis. O. I. Eberhardt is on a trip to Europe. G. F. Benedict, R. R. Ireland and M. Rosok have not yet decided which of several openings to take. The list of non-resident lecturers of the past years is as follows: E. P. Burch, consulting engineer, Minneapolis, "Design of an Electric Light and Railway Plant." "Engineering Features on a Hydro-electric Installation." S. C. McMeen, telephone engineer with Western Electric Company, "The Problems and Prospects in Telephone Engineering." A. C. Pratt, electrical engineer, Missouri River Power Company, Canyon Ferry, Montana, "The Operation of a High Tension Transmission Plant." A. L. Rohrer, electrical superintendent, General Electric Company, Schenectady, "Post-graduate Courses in Electrical Factories."

Trade Notes.

CRESCENT SOLDERING STICK and Crescent soldering paste are fully described in a circular recently issued by the Crescent Company, Chicago.

THE FIBRE CONDUIT COMPANY, Orangeburg, N. Y., makes a fibre conduit for underground electrical work. In a folder recently issued illustrations are given of the various bends, couplings, elbows, etc. A price-list has also been issued.

MACHINE TOOLS.—Under the title "A Reminder of Machine Tools," the Garvin Machine Company, New York, has issued a booklet containing illustrations of many machine tools which may be found in stock in the company's warehouse. The line is very complete.

PASS & SEYMOUR.—Mr. A. M. Little, who for the past few months has represented Pass & Seymour, Inc., Solvay, N. Y., as sales agent in the factory territory, will in future have charge of the Boston branch, where a full and complete line of P. & S. specialties are carried.

THE A. L. DYKE AUTOMOBILE SUPPLY COMPANY, 1402 Pine St., St. Louis, Mo., has removed to 2108 Olive St. The quarters are larger and is on the most prominent street in St. Louis. The company found it necessary to move to larger quarters, owing to its increasing and rapidly growing business.

HYDRA BATTERIES.—The Hydra Battery Company, 70 Reade Street, New York, is sending out a couple of mailing cards giving some information and testimonials on this well-known battery. Attention is also called to the fact that the United States signal service has adopted Hydra batteries for exclusive use.

NOISELESS GEARING.—The New Process Rawhide Company, Syracuse, N. Y., recently issued a booklet containing many telling facts about rawhide noiseless gearing. This gearing is especially adapted to every class of high speed machinery, and by its use power is transmitted noiselessly, directly, cleanly, safely and without loss.

THE W. J. BARR MANUFACTURING COMPANY, of Cleveland, O., which has succeeded to the business of W. J. Barr, manufacturer of telephone arms, has moved into a new factory at 24 to 32 South Water Street, where it

has about four times its former facilities for turning out its goods. The company is bringing out several new styles of telephone arms.

BATTERY FAN OUTFITS.—Under the title "Perfection Battery Fans," Messrs. J. Jones & Son, 64 Cortlandt Street, New York, have issued a catalogue giving a brief description and illustrations of their dry battery fans and the battery used for their operation. The former is properly designed and well constructed and the latter is very snugly packed in a well-made box.

G. M. GEST, the well-known conduit contractor, of Cincinnati, is finding considerable business in the East. Mr. W. T. Jackson, his representative, has been in this section for about ten days past and reports a large amount of work in Boston for the Edison Electric Illuminating Company and again for the street railway company in Schenectady, besides a number of smaller orders in cities of less size.

VENICE IN AMERICA at the Madison Square Garden has some fine lighting effects, as already noted in these pages. The decorative lighting is to be found in the two immense columns or pylons at the foot of the Rialto Bridge and on the ten pillars surrounding the orchestra. This lighting is done entirely with the material of the Elblight Co. of America, inclusive of its special colorings. Other Elblight effects are proposed.

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, recently organized at Mansfield, Ohio, to manufacture electrical machinery, has selected these officers: C. H. Voegele, president; William Dow, vice-president; S. G. Vincent, secretary and manager; Samuel E. Huenerfauth, superintendent. Messrs. Vincent and Huenerfauth were formerly prominently identified with the Phœnix Electric Company, of Mansfield. The company is planning the erection of a factory.

THE WESTINGHOUSE MAGNETIC BRAKE and electric car heating apparatus does not depend upon the trolley circuit, the necessary current being furnished by the car motors acting as generators. The brake may be used at any time independent of the heater, and, conversely, the heater may be arranged to act without reference to the brake. Ordinarily, however, the operation of the heater is dependent upon the use of the brake, the heat produced being derived from the energy that otherwise would be wasted.

HOLTZER-CABOT MOTORS.—In a handsome brochure the Holtzer-Cabot Electric Company, Boston, Mass., shows by means of a few typical examples the latest engineering practice in the application of electric motors to various kinds of mechanical devices. The great flexibility of individual motor drive and the ease with which the Holtzer-Cabot motor adapts itself to widely varying conditions are clearly pointed out. The pamphlet contains 27 excellent half-tone views of machines of many classes driven by electric motor, by belt and direct connection.

ELECTRICAL GLASSWARE.—The Century Glass Company, Bellaire, Ohio, makes a specialty of electrical glassware. It has recently issued a very complete catalogue of its products of this class. The catalogue has 120 pages, containing dimensions, drawings of a great variety of globes, shades, etc., used in electric lighting. The company has just completed some new buildings and added new machinery, which places it in a position to fill orders promptly. It manufactures gas and electric shades—etched; inner and outer globes; arc globes; ball globes and fish globes.

EMERSON ELECTRIC MFG. CO., St. Louis, Mo., is introducing a new type of alternating current fan motor for residences. Its great feature, desirability, being its absolute quietness. In most places noise from a fan motor doesn't make much difference, so much other noise being in evidence. But in the home, even a minor sound often becomes very objectionable, and a loud fan motor is not viewed or heard with favor. The new Emerson type is remarkably still and quiet, and being handsome in design and appearance bids fair to win a great and enduring popularity.

CHLORIDE ACCUMULATORS.—The Electric Storage Battery Company, of Philadelphia, issues an extremely interesting bulletin for May, giving maps of Brooklyn, Chicago, New York and Boston, whereon are located storage battery equipments furnished by the company. With each map there is furnished considerable data as to the date at which the batteries were installed and the aggregate capacity. It is stated that there are now in operation or contracted for in central station lighting service 86 Chloride accumulator battery plants with an aggregate capacity of 841,000 ampere hours.

A FREE PUMP ENGRAVING about 15x20 inches is being offered by the Scranton Steam Pump Company, 1116 Marion St., Scranton, Pa. It claims that it is the largest view of a duplex boiler-feed pump which has ever been engraved. It accurately shows every detail of the Scranton duplex pump across a large engine room, and is suitable for framing, being a good representation of this type of pump. It is nicely printed on coated paper and will be sent free to the first 500 inquirers who enclose the names of six prominent engineers of their acquaintance with addresses; or upon receipt of five two-cent stamps without the addresses.

THE QUINCY ENGINE WORKS, of Quincy, Ill., whose product is so well known to all users of engines, is to be congratulated upon securing an able Chicago representative for its recently established sales agency in that city. Mr. F. R. Jenkins, who, it will be remembered, was with the Chicago Edison Company for a number of years, has opened an office at 938 Monadnock Block, and there is setting forth the merits of the company's product. In a recently issued pamphlet there is briefly described and illustrated a four-plunger pump driven by a motor which may be adapted for the character of the electric current available. The advantages to be derived from the use of such a pump and the superior construction in all its parts are clearly set forth.

AN ODD CATALOGUE.—An oddity in trade publications—from the printer's and binder's standpoint—is a catalogue recently issued by the Consolidated Engine-stop Company, 100 Broadway, N. Y. The cover is a combination affair, one edge being a booklet apparently formed by splitting part of the cover into several leaves; the other edge has attached two postal cards addressed to the Consolidated Company on one side, the other containing a request for a representative to call and talk about an engine stop—perforations enabling the cards to be easily separated. The cover folds in a complicated manner and when tied with an extension of the binding cord, may be mailed, a space on the outside being reserved for the address. The booklet proper consists of 18 pages containing a description and illustrations in detail of the Monarch engine stop.

PANORAMIC PEAKS.—In whatever direction the Colorado tourist may wander by rail, if he goes to the mountains, his journey is a succession of glorious scenery, varying in the characteristics of placid beauty, grotesque ruggedness, and awe-inspiring grandeur. Up the canons are stupendous walls rising perpendicularly, or gradually sloping back toward greater hills, or, yet again, leaning forward above the chasm, as if threatening to come tumbling down—projecting great rocks that hang suspended over the train as it glides smoothly by—a panorama of wonders and grandeur such as belong only to the Rocky Mountains. To enable people to reach Colorado without unnecessary expenditure of time or money, the Union Pacific has put in effect very low rates and splendid train service from Missouri River to Denver. Accommodations provided for all classes of passengers. Full information is cheerfully furnished on application to E. L. Lomax, G. P. & T. Agent, Omaha, Neb.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., is unable to meet the demands of its rapidly increasing business in its former quarters, although it had taken possession of two buildings adjacent to its main building within the last year, and the very large increase in the earlier months of 1903 over all previous records made it necessary that it hasten its former plans of enlargement. It is now able to announce that it has new quarters of suitable size to enable it to maintain good deliveries on all its standard apparatus. This plant is located perfectly for manufacturing purposes, and is fitted with modern equipment in all respects. The present plant has a capacity of fully four times that of the old one, but the rapid increase in orders has rendered it necessary to make further extensions as soon as possible. The factory site is amply large to accommodate all necessary extensions, and the best of service is assured in connection with everything in its line. The new address is West 21st Street & Northwestern Avenue.

AUTOMATIC FIRE ALARM.—The "Copenhagen" thermostat, manufactured by the Copenhagen Automatic Fire Alarm Company, Sheboygan, Wis., is claimed to be exceedingly sensitive to changes in temperature, and the instant the temperature reaches the acting point the electric circuit is closed and the location of the excessive heat is indicated on an annunciator. The device is fastened to the ceiling of the room to be protected and electrically connected with the annunciator and one or more alarm bells. The bell continues to ring as long as the abnormal heat exists. The importance of a device of this sort may be appreciated from the fact that a fire, as is well known, can be more easily extinguished in its earliest stages, and this device is designed to indicate the existence of a fire and its location in its incipient stages and thus enable the taking of prompt meausres to extinguish it. It is a very simple device and the contact is made with a sharp snap. It is dust proof and there is no danger of closing the circuit accidentally by jarring. Testimonial letters indicate that the Copenhagen thermostat is doing its work well and has been the means of saving much property from destruction.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 16, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

730,576. ELECTRIC ALARM SYSTEM; Solomon Schwarzchild, Rochester, N. Y. App. filed July 25, 1902.

730,858. TELEGRAPH INSTRUMENT; Martin Armstrong, Kenney, Texas. App. filed Feb. 28, 1902. A transmitter consisting of a board having a series of grooves in its face, each groove representing a character and containing metal contacts suitably spaced apart so that when a stylus is drawn through a groove, the circuit is made and broken in accordance with the arrangement of the metal contacts therein.

730,860. ELECTRIC-MOTOR SYSTEM; George O. Baker, New York, N. Y. App. filed May 10, 1901.

730,864. AUTOMATIC FIRE ALARM; Damase Beaulieu, St. Ulric, Canada. App. filed Dec. 29, 1902. A stretched cord normally holds a dridging piece out of contact with two terminals.

730,869. ELECTRIC RAILWAY; William M. Brown, Johnstown, Pa. App. filed July 29, 1902. In a button contact system the car magnet sometimes picks up stray pieces of iron and carries them against the rails of the branch tracks, causing a short circuit which is liable to open the circuit breaker at the power station. To avoid this, portions of the branch track are connected with feeders carrying a low current, merely enough to propel the cars, but not sufficient to cause a disturbance of the system.

730,891. MEANS FOR OPERATING ALTERNATING CURRENT ELECTRIC MOTORS; Rudolf Eickemeyer, Yonkers, N. Y. App. filed July 6, 1894. A rotary switch acting to intermittingly short circuit sections of the field coils which are unsymmetrically located with reference to the connections with the supply terminals, the coils being freed from short circuit after the initial rotation of the armature has been accomplished.

730,893. ELECTRICAL TRANSFORMER; Augustine R. Everest, Lynn, Mass. App. filed May 8, 1902. The main cover of the transformer is provided with a small cover affording access to the connection board.

730,898. ELECTRIC-ARC LAMP; Richard Fleming, Lynn, Mass. App. filed Sept. 22, 1902. (See page 1102.)

730,899. MULTIPHASE ARC-LAMP; Richard Fleming, Lynn, Mass. App. filed Dec. 22, 1902. (See page 1102.)

730,906. FUSE TERMINAL; William R. Goodman, Chicago, Ill. App. filed April 3, 1902. The end piece embraces two sides of the fuse strip.

730,967. DYNAMO ELECTRIC MACHINE; Henry G. Reist, Schenectady, N. Y. App. filed Feb. 27, 1897. The flanges which support the overhanging ends of the coils are so constructed as to be only slightly magnetized and thus react only slightly on the winding.

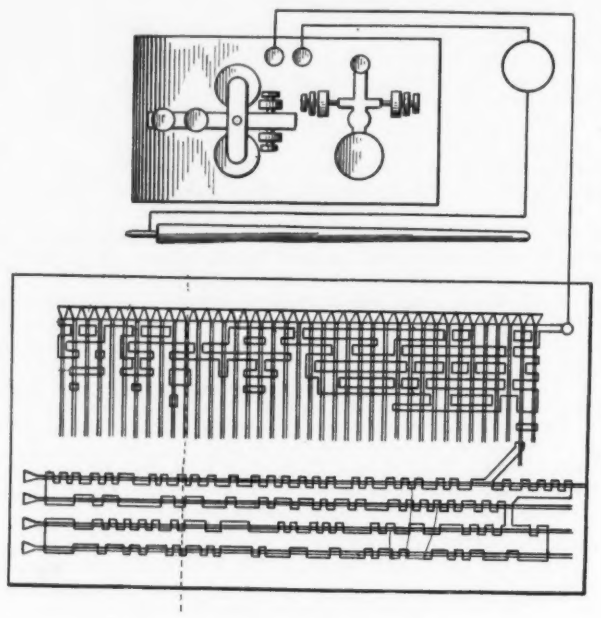
730,975. CONTACT DEVICE; Howard R. Sargent, Schenectady, N. Y. App. filed Aug. 31, 1900. Details of a branch plug.

731,000. CONTROLLING ELECTRIC BOOSTERS; Merle J. Wightman, West New Brighton, N. Y. App. filed June 5, 1901. The booster is provided with means for demagnetizing its field when the driving motor ceases to operate; this prevents it from running away under the current of the feeder circuit.

731,005. PLUG-FUSE; Herbert C. Wirt, Schenectady, N. Y. App. filed March 24, 1902. (See Current News and Notes.)

731,016. INSULATED JOINT FOR RAILWAY RAIL JOINTS; Bancroft G. Braine, New York, N. Y. App. filed Oct. 22, 1900. Details.

731,025. ELECTRIC ARC LAMP; John L. Davies, London, Eng. App. filed Feb. 11, 1902. General improvements relating to the frame work and the arrangement of the regulating mechanism thereon.



730,858.—Telegraph Instrument.

731,029. METHOD OF UTILIZING THE ENERGY OF WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed May 4, 1903. (See Current News and Notes.)

731,035. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed March 1, 1900. (See Current News and Notes.)

731,036. DIAMAGNETIC SEPARATION; Elmer Gates, Chevy Chase, Md. App. filed March 1, 1900. (See Current News and Notes.)

731,037. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed Jan. 13, 1903. (See Current News and Notes.)

731,038. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed March 1, 1900. (See Current News and Notes.)

731,039. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed March 1, 1900. (See Current News and Notes.)

731,040. DIAMAGNETIC SEPARATION; Elmer Gates, Chevy Chase, Md. App. filed March 19, 1900. (See Current News and Notes.)

731,041. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed March 19, 1900. (See Current News and Notes.)

731,042. DIAMAGNETIC SEPARATION; Elmer Gates, Chevy Chase, Md. App. filed March 19, 1900. (See Current News and Notes.)

731,043. SEPARATING DIAMAGNETIC METAL FROM SANDS, ETC.; Elmer Gates, Chevy Chase, Md. App. filed April 14, 1900. (See Current News and Notes.)

731,044. DIAMAGNETIC SEPARATION; Elmer Gates, Chevy Chase, Md. App. filed April 14, 1900. (See Current News and Notes.)

731,045. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed April 14, 1900.

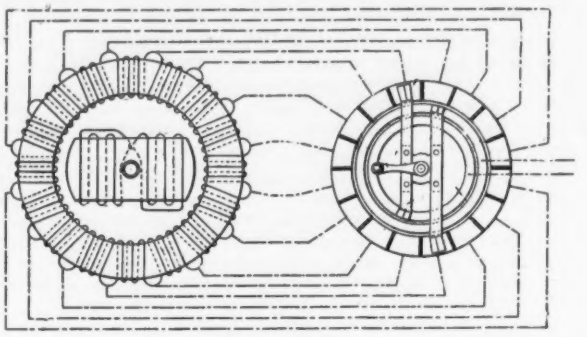
731,056. ELECTROMAGNETIC VIBRATING REED; Sterns F. Jones, Brooklyn, N. Y. App. filed Sept. 23, 1902. The reed is mounted between springs which give it a return impetus after each stroke.

731,125. CARRIER; Stuart H. Patterson, Plainfield, N. J. App. filed Dec. 19, 1902. The track is divided into sections which are magnetized successively to attract the wheels of a vehicle, the switching mechanism being the wheels themselves coacting with contacts on the rail.

731,166. ELECTRIC TELEPHONE SYSTEM; Hiram D. Currier, Ottawa, Ohio. App. filed May 16, 1902. (See page 1099.)

731,195. WATER-TIGHT UNION FOR LEAD CABLES; George L. Martin, New York, N. Y. App. filed March 4, 1903. Details.

731,209. RESISTANCE SET; Edwin F. Northrup, Philadelphia, Pa. App. filed March 20, 1903. (See Current News and Notes.)



730,891.—Means for Operating Alternating Current Motors.

731,210. RESISTANCE SET; Edwin F. Northrup, Philadelphia, Pa. App. filed March 31, 1903. (See Current News and Notes.)

731,279. ELECTRIC CLOCK; Joseph A. Carruthers, St. James, Victoria, Australia. App. filed Oct. 10, 1902. Details of construction.

731,280. ELECTRIC CLOCK; Joseph A. Carruthers, St. James, Victoria, Australia. App. filed Oct. 10, 1902. Details of construction.

731,284. TROLLEY ARM; Judson T. Cousins, Norwich, Conn. App. filed May 12, 1902. The trolley harp is readily removable from the end of the pole in order to change wheels.

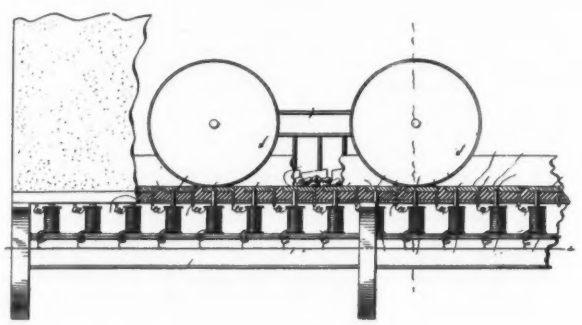
731,298. ELECTRIC CONTROLLER; George W. Gilmore and David Kendall, Alliance, Ohio. App. filed March 12, 1903. A starting box having a brush holder which automatically acts to insure good contact between the brushes and the pieces electrically engaged thereby.

731,308. METHOD OF PRODUCING ELECTRODES FOR ELECTRIC ACCUMULATORS; Ernst W. Jungner, Stockholm, Sweden. App. filed Aug. 5, 1901. The method of making carriers for active masses of accumulator electrodes that are chemically indifferent to alkaline solutions, which consists in placing a suitable cathode and a suitable metal plate as anode in a solution of an alkali-metal hydrate containing alkali-metal chloride and passing a current of electricity.

731,339. APPARATUS FOR HEATING FLUIDS OR FLUID MIXTURES; Frank S. Chapman, Kenton, Ohio. App. filed March 28, 1901. Electrically heated plates are inserted in a pipe which carries the fluid to be heated.

731,364. ELECTROMAGNETIC-TRACTION-INCREASING APPARATUS; Albert A. Honey, Tacoma, Wash. App. filed Dec. 28, 1901. (See page 1102.)

731,365. ELECTROMAGNETIC-TRACTION-INCREASING APPARATUS; Albert A. Honey, Tacoma, Wash. App. filed Dec. 28, 1901. (See page 1102.)



731,125.—Carrier.

731,375. ELECTRIC CONTROLLER FOR ELECTRIC MOTORS; William K. Liggett, Columbus, Ohio. App. filed Dec. 22, 1902. General improvements in the construction of a motor controller for elevators whereby positive contacts are obtained and a proper operation of the reversing, starting and resistance switches is accomplished.

731,382. DEVICE FOR ATTACHING DYNAMOS TO RAILWAY CARS; James F. McElroy, Albany, N. Y. App. filed Jan. 11, 1900. The dynamo is mounted to swing from the center of the truck so that its armature shaft will always be parallel to the axle from which it is driven.

731,400. TERMINAL TIP FOR ELECTRIC WIRES; Harry L. Worthington, New York, N. Y. App. filed Feb. 27, 1903. The tip has a pair of wings around which the end of the wire is fitted, and separate means for clamping the wire to the tip.

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ELECTRICAL WORLD AND ENGINEER

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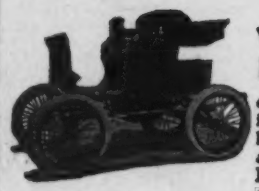

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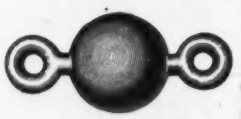

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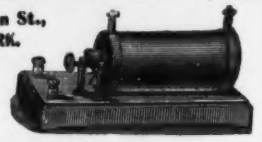

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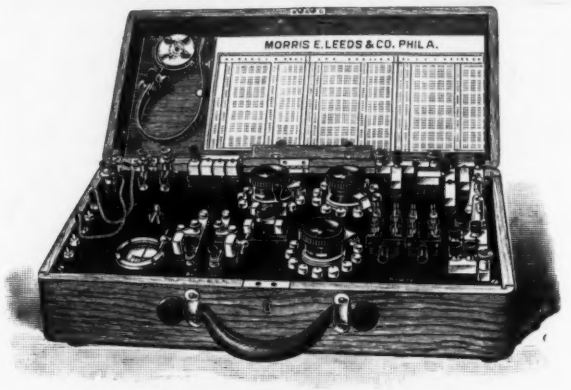

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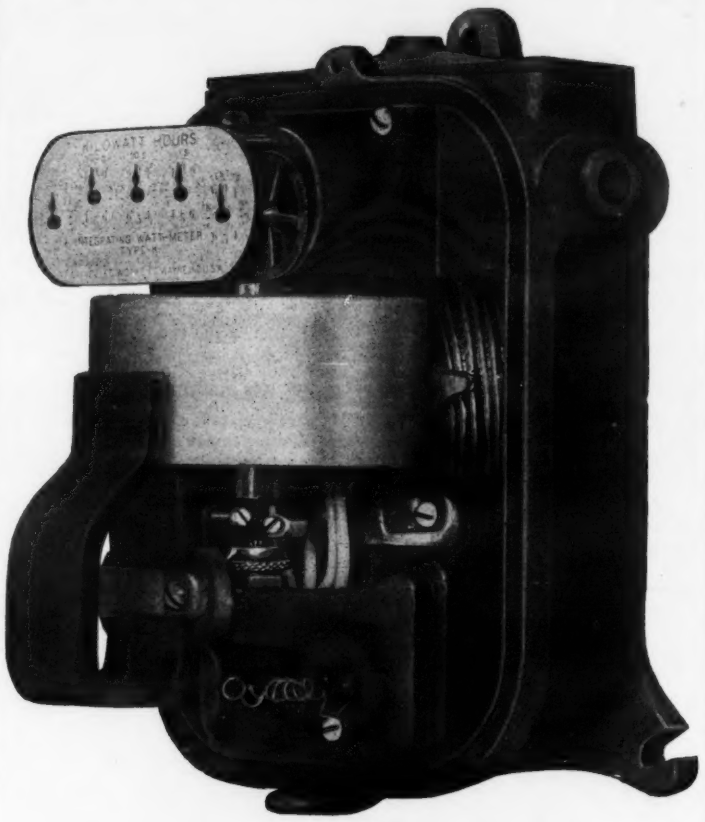

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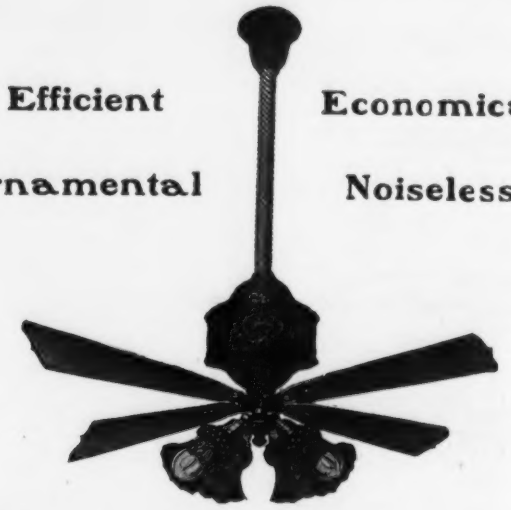

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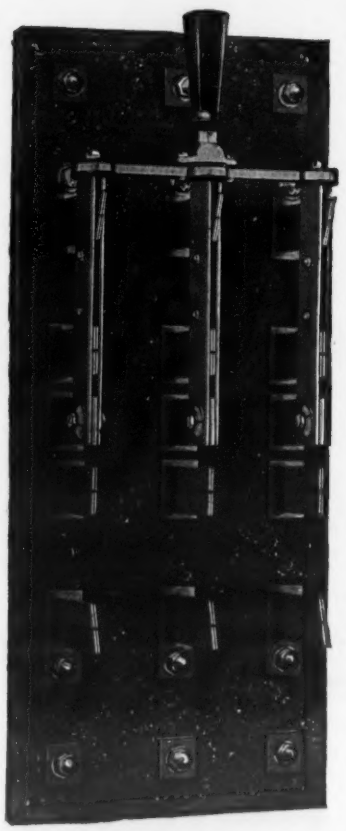

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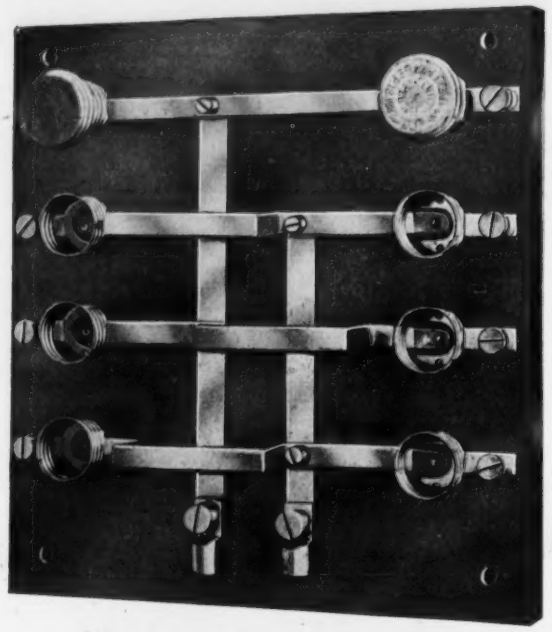

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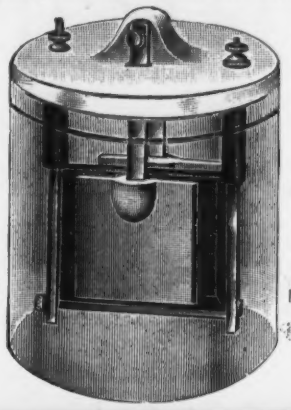

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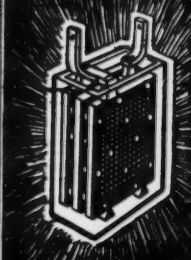

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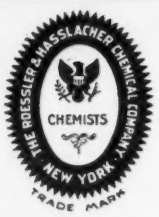

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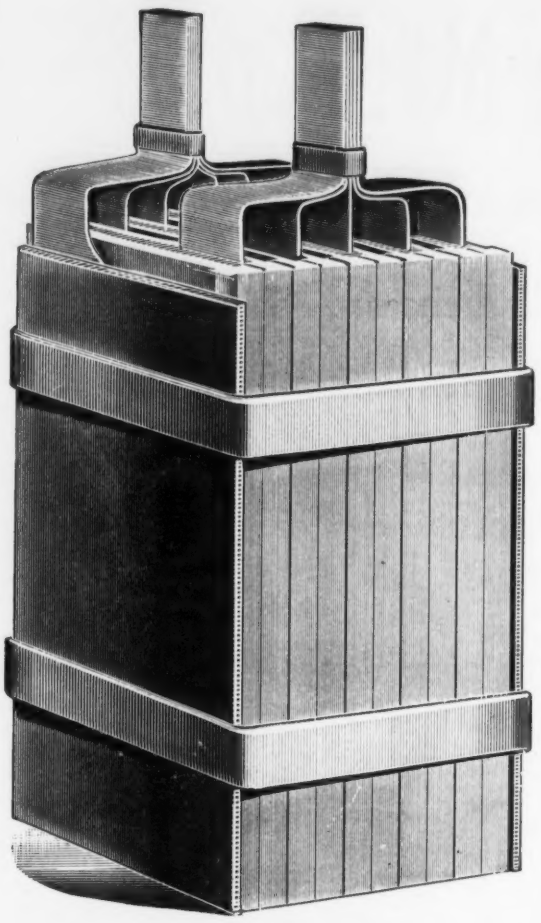

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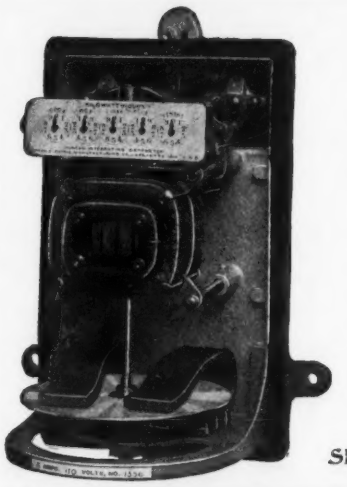

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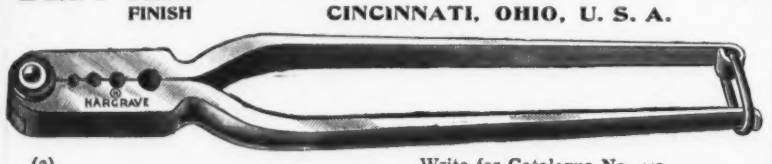

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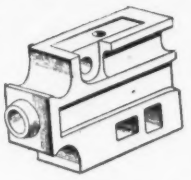

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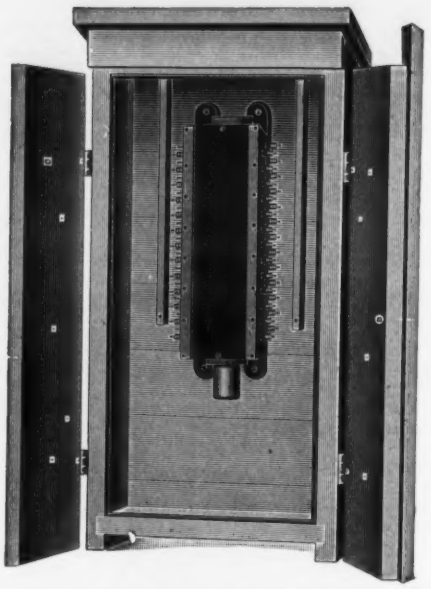

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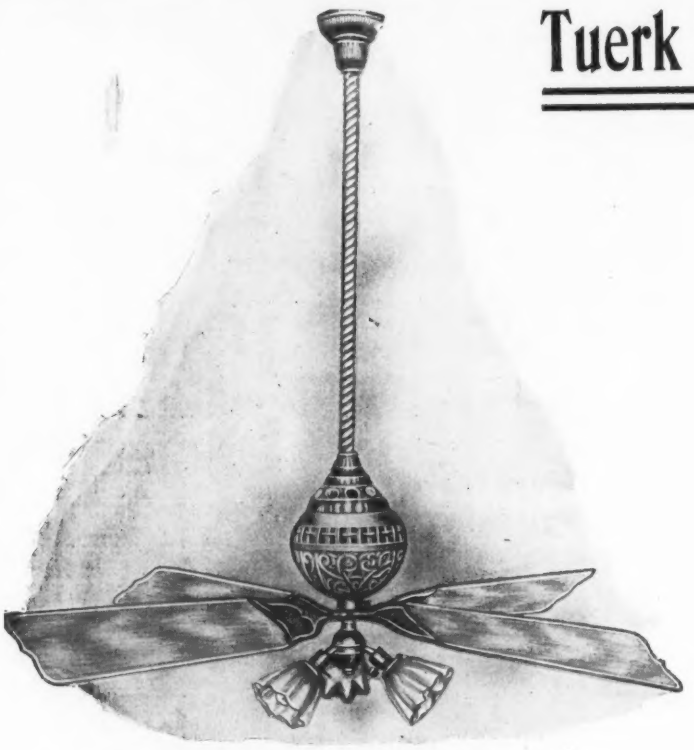

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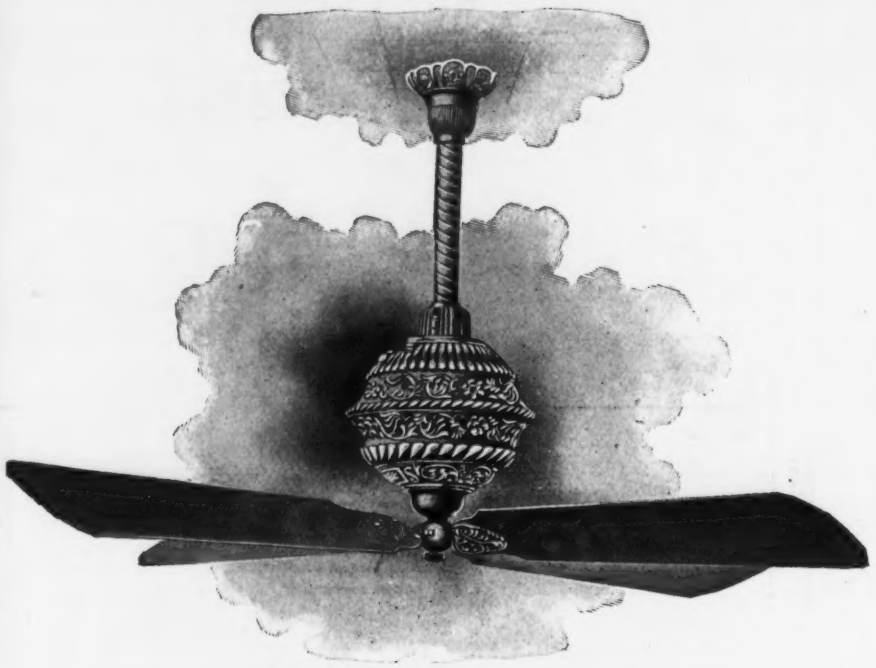

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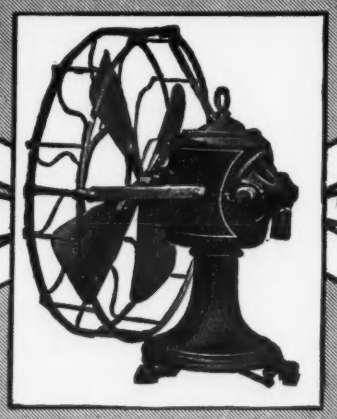
NO REPAIRS! NO NOISE! NO TROUBLE!



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MAXIMUM VOLUME OF AIR

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Alternating and Direct Current Fan Motors

MAY BE RELIED UPON FOR
CONTINUOUS SERVICE
SEASON AFTER SEASON.

Twelve-inch swivel and trunnion frame direct current fan motor.

THIS PLATE ON EVERY MOTOR.

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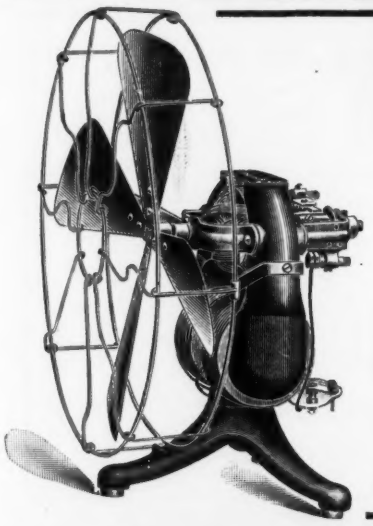
Twelve-inch swivel frame alternating current fan motor.

NEW YORK OFFICE: 44 Broad Street. Sales Offices in all Large Cities.



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507 WEST 51ST STREET, NEW YORK.

We are designing and manufacturing for the Fall trade some of the newest ideas in electrical novelties for the Holiday Season. Fall Catalogue ready about Sept. 1st.

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Flexible Metallic Conduit

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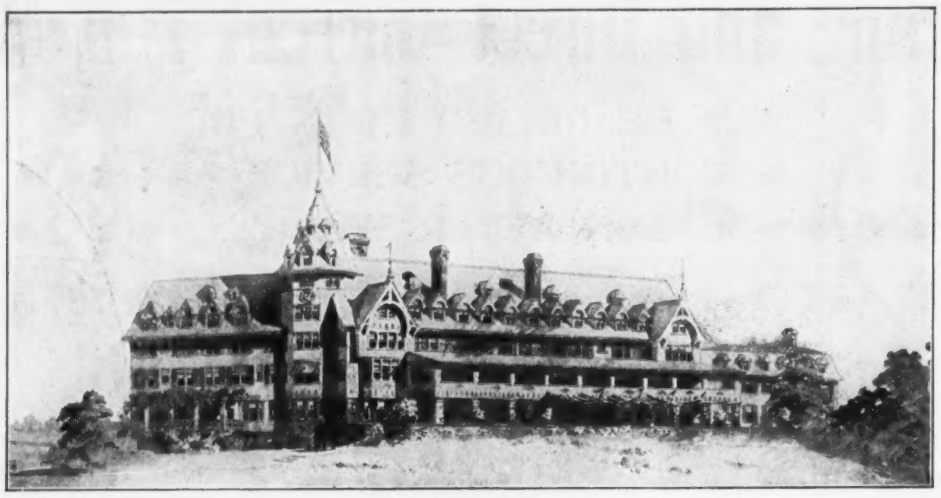

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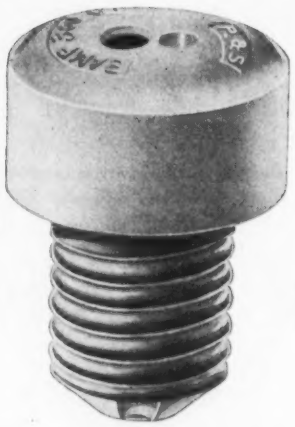

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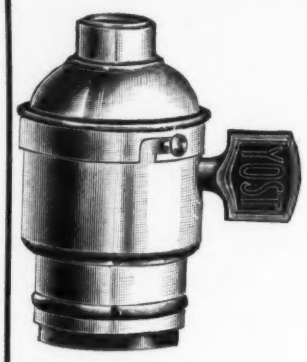

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Good to look upon.

Purse Swellers.

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(*if you are in business to stay*).

If you have investigated we probably have your order—if you haven't why don't you? It will pay you and may be us also.

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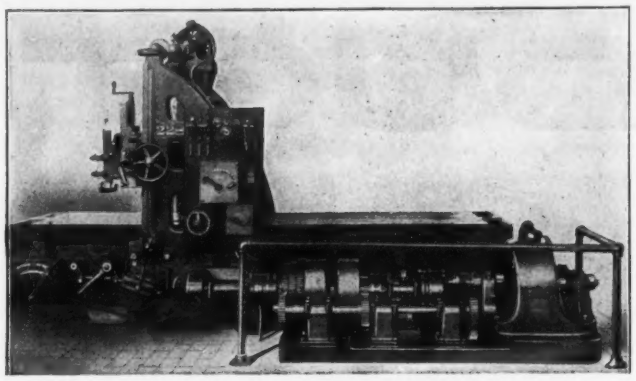
JOHN R. COLE, 33 Second Street, San Francisco
W. C. JESSUP, 203 Lewis Building, Pittsburg

Magnetic Clutch Drives



Do away with driving belts entirely and enable the operator to vary the speed of the cutting table.
Catalogs explain how.

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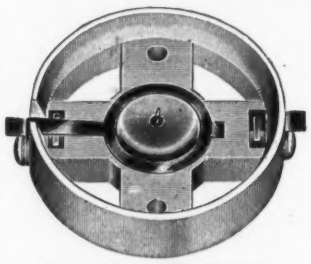

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The ONLY actually reliable in existence.
No experiment! In extensive use since 1889.
Simplicity itself; cannot get out of order.
Dustproof.
Only HEAT can close circuit, and NO LIMIT to number of times this may be done.

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Elevator Controllers

Neat
Simple
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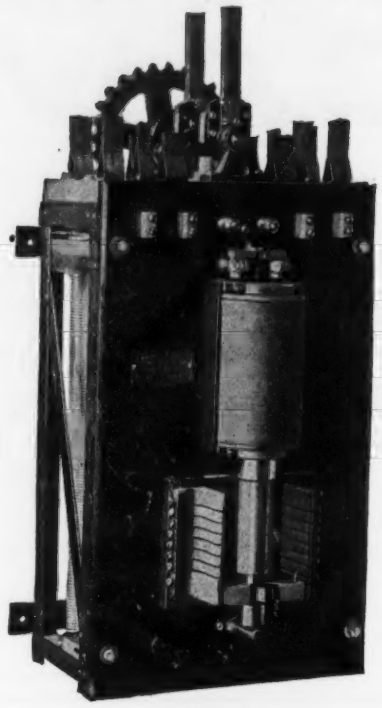

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OLDEST, BEST, and have stood the test of time

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For Electrical Purposes...
Silk for Insulating Finest Wire
ALL KINDS BRAIDING SILK.

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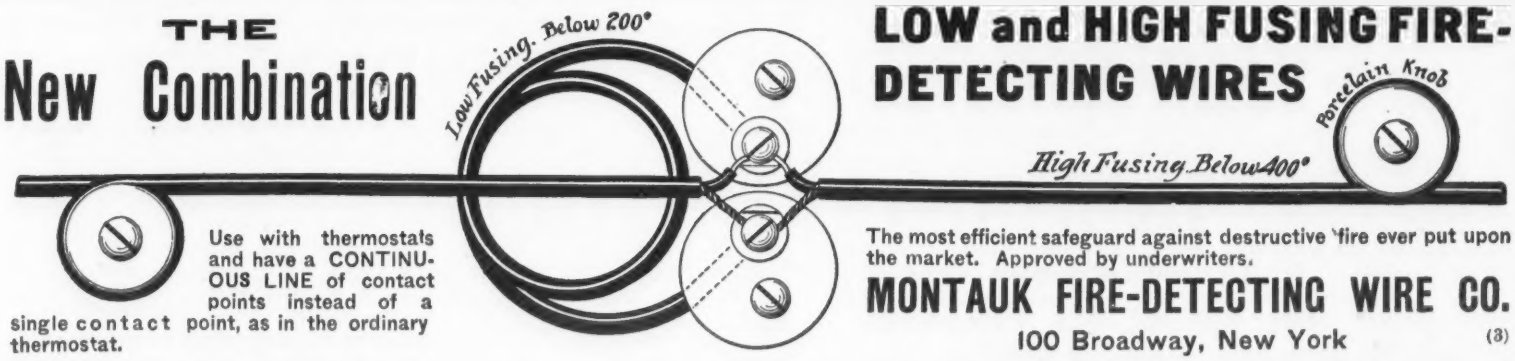

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He will tell you all about it
He lives in every city where duct is used

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American Vitrified Conduit Co.,
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STANDARD VITRIFIED CONDUIT CO.

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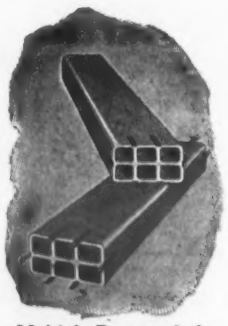

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We have one of the largest and best equipped factories, with improved machinery. We have a corps of skilled workmen who know how to make good Conduit. We have unequaled shipping facilities.
The SINGLE DUCT is self-centering.
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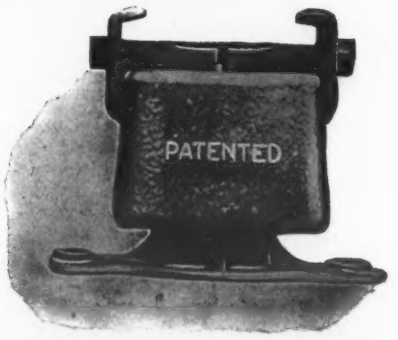

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The Ideal Flexible Conduit for Interior Wiring

"ELECTRODUCT" THE Original Enamelled Steel Conduit

APPROVED BY ALL BOARDS OF FIRE UNDERWRITERS IN THE UNITED STATES

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Uncle Sam uses the Benson pipe and electric conduit bender in the great navy yards at New York, Philadelphia, Boston, San Francisco, and Norfolk. Endorsed by leading electrical contractors. List price, thirty dollars. Thirty days' trial free. A one half inch unit conduit bender for three dollars net. Weight, five pounds.

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IT SIGNIFIES QUALITY
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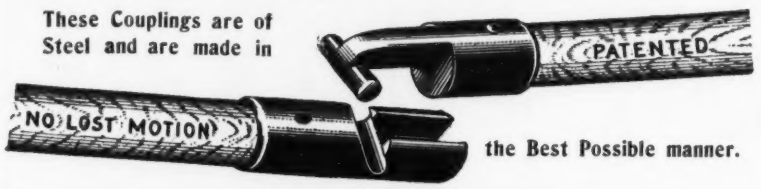
You can increase the efficiency of your advertising by sending us NEW CUTS frequently.

Cope's Patent Quick Coupling Conduit Rod
Remember these Rods have no lost motion.

These Couplings are of Steel and are made in



the Best Possible manner.

PATENTED FEBRUARY 24, 1903.
Write for list of persons using these Rods—26,000 sold since May, 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents. 4 ft. 85 cents.
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For Electric Wires
ALPHADUCT MFG. CO.
522-524 W. 22d ST.
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NEW YORK, Wm. S. Brown, 39 Cortlandt St.
CHICAGO - Wm. M. Porter, Fisher Building.
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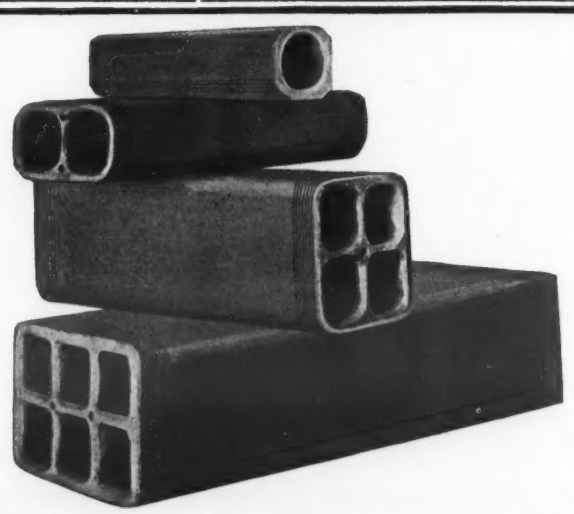

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Superior Conduits for Underground Wires a Specialty

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The Most Complete Street Railway Directory and Financial Manual

NEW YORK. AMERICAN STREET RAILWAY INVESTMENTS. 143

LIABILITIES.

	1899.	1900.	1901.	1902.	1903.
Capital stock	$300,000	$300,000	$300,000	$300,000	
Funded debt	350,000	350,000	950,000	950,000	
Accounts payable	48,310	93,513	16,314	83,887	
Loans and bills payable			65,373		
Receiver's certificates			10,779		10,855
Profit and loss (surplus)					8,845
Total	$698,310	$653,513	$942,466	$848,987	

PLANT AND EQUIPMENT.—Miles of track (electric) 15; gauge, 4 ft. 8½ in.; 70 lb. rail; 6 motor cars 9 freight cars, 1 snow plow; Corliss engines, West. dynamos and motors, Brill and Jackson & Sharp cars.

OFFICERS.—Pres. W. Barlow Dunlap, V. Pres. & Gen. Man. F. H. Beach, Sec. Geo. A. McOmber, Treas. H. M. Shaw.

DIRECTORS.—W. B. Dunlap, Amsterdam, N. Y.; J. W. Wisnall, W. S. Waterbury, F. H. Beach, J. W. Cleveland, C. E. McOmber, Ballston Spa.; C. E. Cady, Middle Grove; Thos. T. Barrett, H. M. Shaw, New York.

GENERAL OFFICE, Ballston Spa.

Date of information, Sept., 1902. b

BINGHAMTON.

Population in 1880, 17,317, in 1890, 35,005, in 1900, 30,647, total population served, including villages of Lestershire, Endicott, Union, Hooper and Port Dickinson, 60,000.

Binghamton Railway Co.—Chartered Sept. 30, 1902. This is a consolidation of the following companies originally operating in Binghamton:

Binghamton & Port Dickinson Ry. Co.	incorp.	1866
Washington Street & State Asylum R. R. Co.	"	1871
Park Avenue R. R. Co.	"	1882
Washington Street, Asylum & Park R. R. Co.	"	1887
Binghamton Central R. R. Co.	"	1883
City Ry. Co.	"	1885
Court Street & East End R. R. Co.	"	1886
West Side Street Ry. Co.	"	1887
Binghamton Street R. R. Co.	"	1890
Binghamton R. R. Co.	"	1894
Binghamton, Lestershire & Union R. R. Co.	"	1894

Capital Stock, authorized, $1,150,000, issued, $792,800, par value, $100 per share.

Funded Debt, direct, $1,373,000 as follows:

First consolidated mortgage 5 p.c. gold bonds, authorized, $2,500,000, issued, $1,373,000, in escrow (see Note), $1,127,000; coupon, but may be registered; dated Dec. 10, 1901, due 1931; denom. $1,000; int. payable May and Nov., at office of the Fidelity Trust Co., of New York, or Seaboard National Bank, New York, trustee of mortgage.

Note.—The mortgage or trust deed, dated Dec. 10, 1901, provided for an ultimate total issue of bonds of $2,500,000, of which $1,150,000 were placed in escrow with the trustee, to redeem underlying bonds of the Binghamton R. R. Co., and the Binghamton, Lestershire & Union R. R. Co., the issue of bonds being a first mortgage on all of the property of the consolidated lines. $101,000 of the underlying bonds have already been retired in accordance with the above provision.

Of the remaining bonds, $1,200,000 were also placed in escrow with the trustee to provide for future extensions, betterments and improvements. The mortgage provides that the $1,200,000 of bonds shall be certified by the trustee only upon presentation to said trustee of verified certificates of disbursements or vouchers of expenditures executed by the officers of the Railway Company, and it is further expressly provided that bonds in excess of $1,500,000 shall not be certified by the trustee except upon the written request of stockholders owning at least 51 per cent of the capital stock of the company, specifying the amount of bonds so to be issued and the purpose or purposes for which the proceeds of said bonds are to be used and that the issuance of bonds in excess of that amount shall be consented to by the Board of Railroad Commissioners of the State of New York.

Franchises.—In addition to the old and valuable charters originally granted to its constituent companies, the Binghamton R. R. Co. secured, in 1892, franchises practically exclusive and perpetual, that permit street railway operation in the City and in the villages of Port Dickinson and Lestershire. Existing perpetual contracts between the Binghamton Railway Co. and the city of Binghamton, the villages of Lestershire and Union, and the town of Dickinson, provide that the Binghamton Railway Co. is to pay one-fifth of the expense of all new paving between the rails of its tracks and are exempted from any portion of expense of maintenance and repairs of paving between the rails of its tracks or outside thereof.

Operation.—Year ending Mar. 31.

	1899.	1900.	1901.	1902.	1903.
Gross receipts	$160,348	$173,494	$184,256	$206,447	$217,661
Operating expense	90,051	100,240	101,896	113,308	124,938
Earnings from operation	70,297	73,254	82,360	93,139	92,723
Deductions from earnings					
Taxes	5,400	5,550	6,000	6,000	6,150
Interest	48,242	43,473	45,816	54,549	58,916
Rentals	6,311	6,810	6,563	3,750	
Net income	10,344	17,981	23,981	28,847	27,657
Total surplus account	96,348	113,643	129,198	144,085	153,836
Per cent. operating exp. to total receipts	56	57	55	55	57

Balance Sheet.—Dated Mar. 31.

ASSETS.	1899.	1900.	1901.	1902.	1903
Cost of road and equipment	$1,627,964	$1,695,613	$1,754,767	$2,016,444	$2,331,745
Cash on hand	10,913	9,542	9,002	44,905	18,797
Current assets	17,399	1,363	1,869	3,197	4,515
Bills and accts. receivable	24,418	23,612	33,850	72,418	48,726
Supplies	2,747	3,061	3,083	8,132	7,499
Total	$1,683,441	$1,732,103	$1,803,471	$2,145,026	$2,411,192

LIABILITIES.

Capital stock	$ 519,970	$ 545,775	$ 552,000	$ 700,860	$ 792,800
Funded debt	957,000	974,000	997,000	1,210,000	1,373,000
Bills payable	81,655	72,321	100,440	35,000	30,055
Accrued interest	7,900	8,113	8,400	13,529	18,089
Accts. payable	20,568	18,341	16,439	41,612	41,912
Profit and loss (surplus)	96,348	113,643	129,198	144,085	153,836
Total	$1,683,441	$1,732,103	$1,803,471	$2,145,026	$2,411,192

Note.—Above statement for years ending Mar. 31. 1899, 1900, and 1901 includes the statistics and results of operation of the roads merged into the Binghamton Ry. Co., and for the years ending Mar. 31, 1901, and 1902, of the consolidated company.

Dividends in 1901, 1902 and 1903, 2 p. c.

Plant and Equipment.—Miles of track (electric), 37.25; gauge, 4 ft. 8½ in.; 40 lb. to 94 lb. T and girder rail; 72 motor and 40 trail cars; Hall & Wood, and McIntosh & Seymour, C. C. engines, also 750 H. P. vertical Hall & Wood engine, direct connected with 500 K. W. Gen. Elec. generator, rotary converters and accessories, also substation located at Endicott, N. Y. fully equipped with rotary transformers, etc., Gen. Elec. dynamos and motors, Stephenson, Brill and Lachede cars.

Officers.—Pres. G. T. Rogers, V. Pres. George E. Green, Sec. Jos. M. Johnson, Treas. H. C. Hardie, Gen. Man. Supt. & Pur. Agt. J. P. E. Clark, Ch. Engr. of Power Station John H. Cole, Mast. Mech. F. W. Summers.

Directors.—G. T. Rogers, C. J. Knapp, John B. Rogers, Jos. M. Johnson, Geo. E. Green, F. E. Ross, T. J. Keenan, T. S. Rogers, Stoddard Hammond, J. P. E. Clark, all of Binghamton, N. Y., and J. W. Cunningham, of New York City.

General Office, Power Station, Binghamton, N. Y.

References.—Description of park (brief), Vol. XVII, June 1, '01, p. 663.

Date of information, Apr., 1903.

For map of road see page 146.

BROOKLYN.

Population in 1880, 599,495, in 1890, 838,547, in 1900, 1,166,582.

Brooklyn Rapid Transit Co.—Chartered Jan. 17, 1896, under the laws of New York, as the successor to the Long Island Traction Co., whose assets were purchased under foreclosure of the collateral trust deed and transferred to the Brooklyn Rapid Transit Co. Annual meeting, last Friday in Jan. This company was organized for the purpose of controlling various street railway properties in Brooklyn through ownership of stock, and is not an operating company. The earnings are derived from interest on invested funds, and from the surplus earnings over and above interest and guaranteed dividend charges of the operating companies which it controls. For description of leases and of the guarantee fund see Brooklyn Heights R. R. Co.

The Brooklyn Rapid Transit Co., and its constituent companies, own the following securities:

1,462.25 shares capital stock Brooklyn Rapid Transit Co., par value	$146,228
Entire capital stock Brooklyn Heights R. R. Co., which includes equity in 999 year lease of Brooklyn City R. R. Co. to Brooklyn Heights R. R. Co., par value	200,000
Entire capital stock, Brooklyn, Queens County & Suburban R. R. Co., par value	2,000,000
Entire capital stock, Sea Beach Ry. Co., par value	650,000
110,939.36 shares common stock of the Brooklyn Union Elevated R. R. Co., par value	11,093,936
46,411.59 shares 5 p. c. non-cumulative preferred stock of the Brooklyn Union Elevated R. R. Co., par value	4,641,159

Please note date of information at end of each report.

(ONE-QUARTER SIZE)

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AMERICAN STREET RAILWAY INVESTMENTS

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We have confidence in every foot of **FLEXDUCT** sold; we know what it will do; we know what it has done in the past; when you sum up all the good points an interior flexible conduit should possess, you have only described the merit which lies in **FLEXDUCT.**

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For Underground Electrical Work

Electrolysis Proof
Non Abrasive
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Non Corrosive

Made in 7 foot Lengths. 2 to 8 inches inside Diam.

This Conduit stops destruction of Cables by eliminating electroysis and all cutting and wearing which usually accompanies the drawing in :: :: :: :: :: :: ::

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Call Complete for Service

The Electric Carriage Call Annunciator

NOT only for theatres and night use

BUT for department stores, business houses, etc., day or night

Overcomes the annoyance and delay which follows the old style plan of "calling" carriages after the theatre, opera or reception.

It is an absolutely perfect device. It can be depended upon always to work. It is most simple in operation.

They are giving satisfaction where now in use, and are easily installed. Correspondence invited.

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THE ALLEN
SOLDERING TICKS (A FLUX)

MAKES SOLDER FLOW.

Officially approved by Underwriters National Electrical Association.

Big Sample Free.

L. B. ALLEN, Inc., Sole Makers.
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The only turn-down lamp anybody ever bought again. 1

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EVERYTHING ELECTRICAL SEND FOR "GREEN BOOK"

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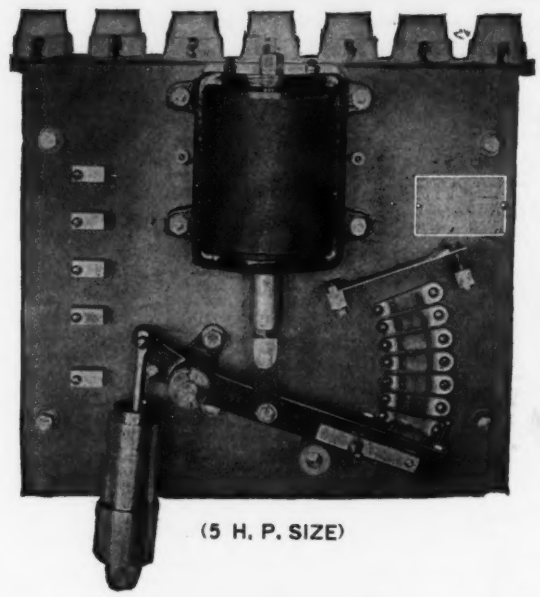

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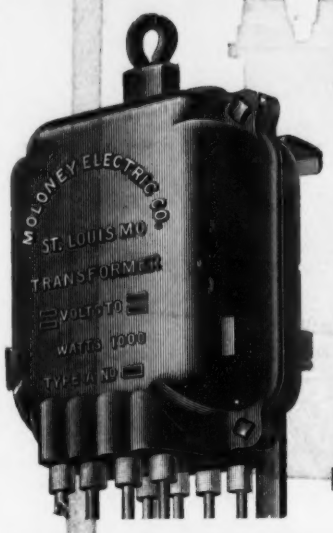

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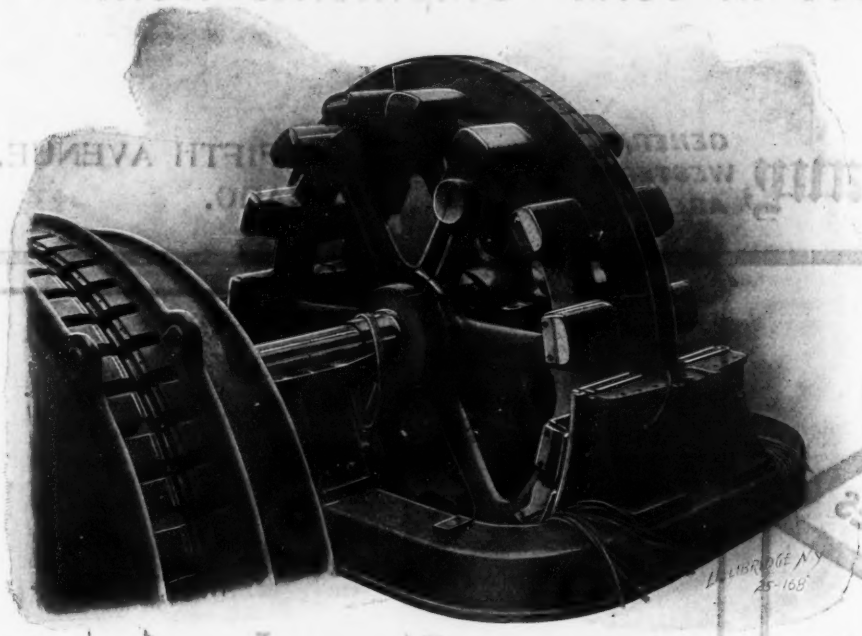

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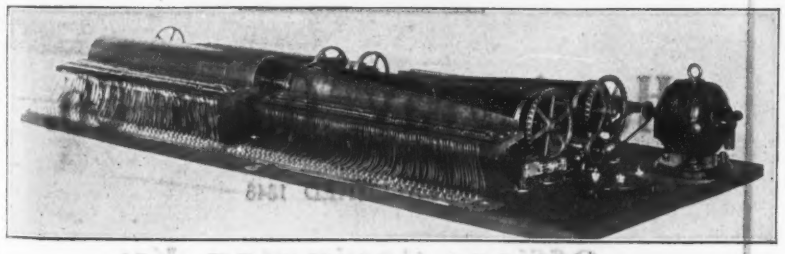

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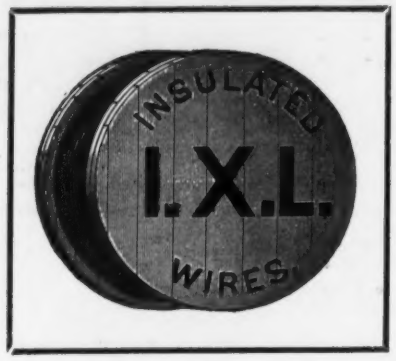

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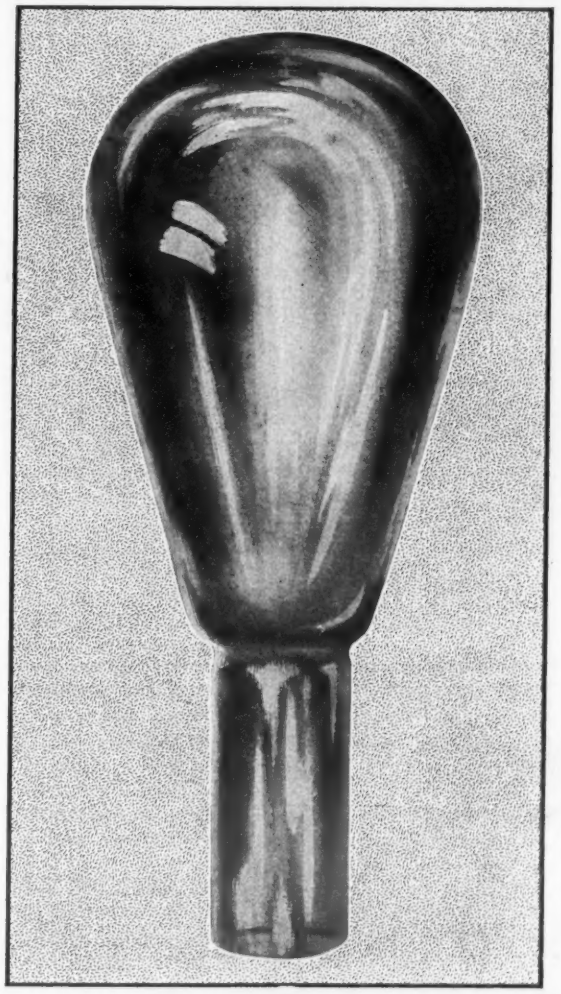

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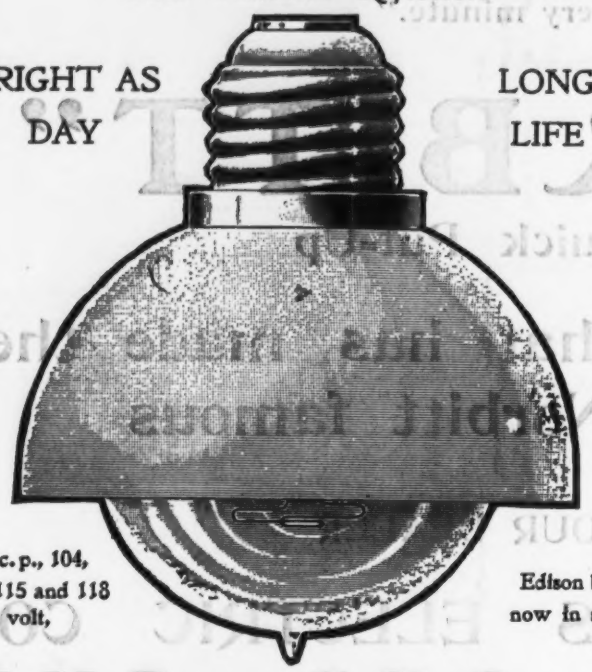

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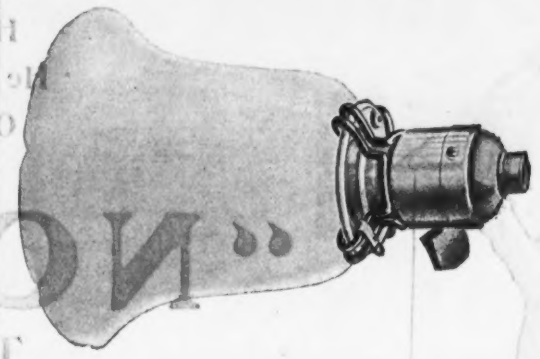

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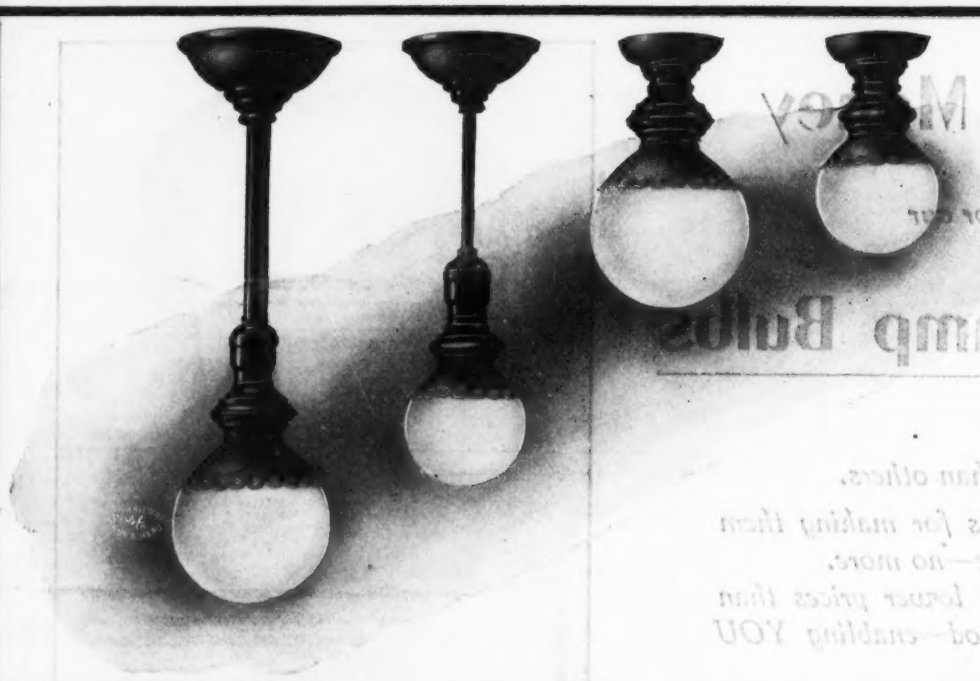

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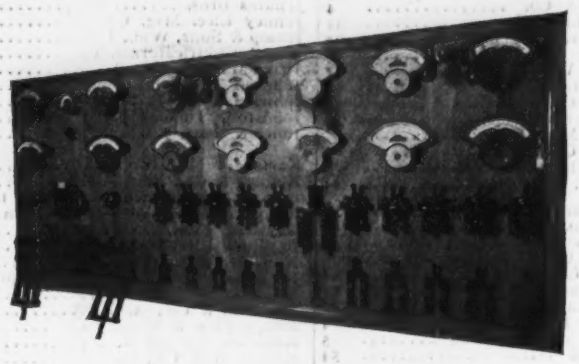

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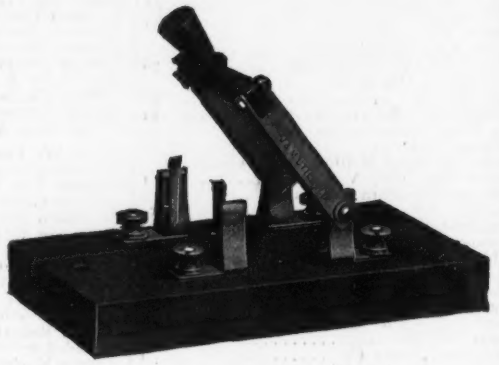

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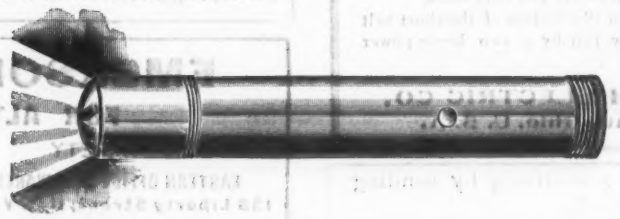

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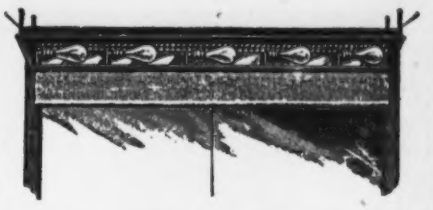

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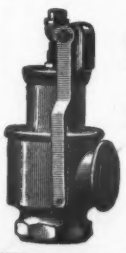

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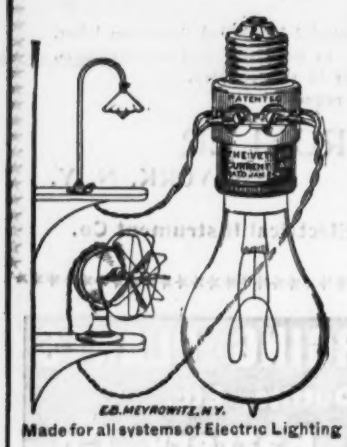

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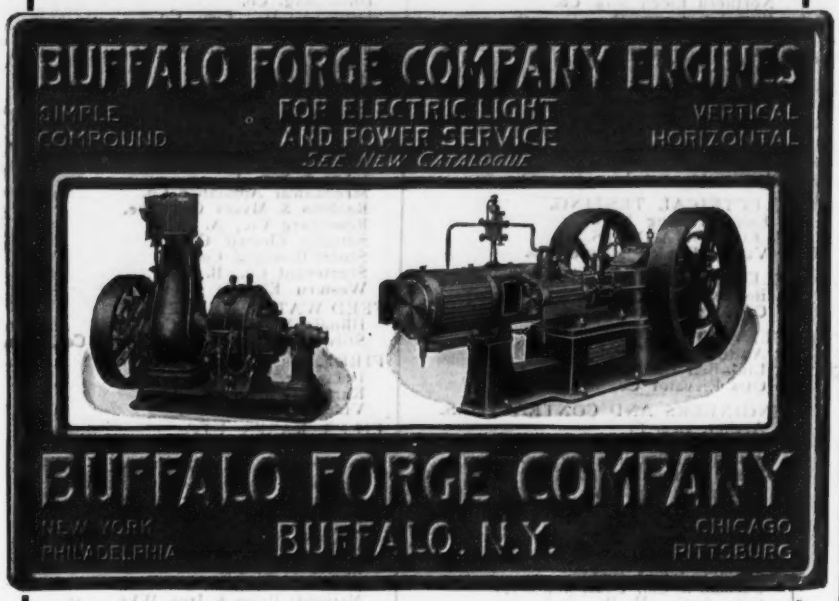

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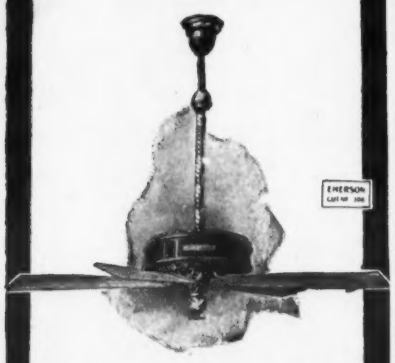

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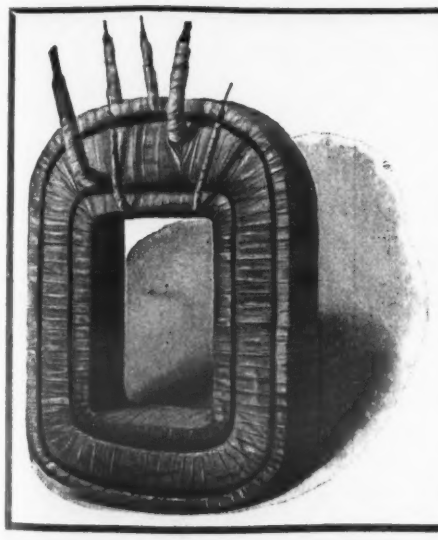

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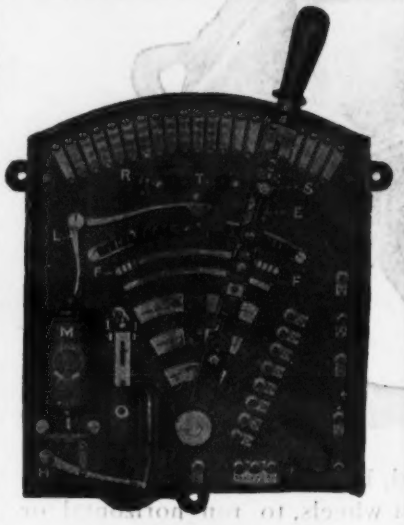

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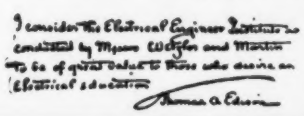

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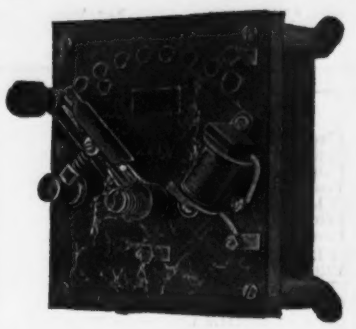

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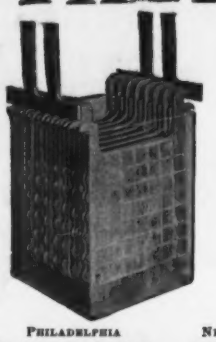

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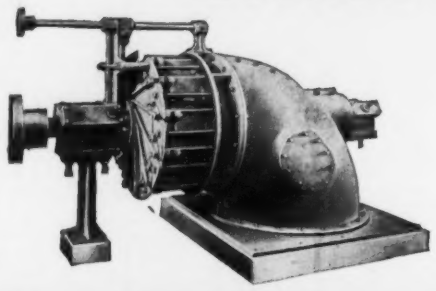

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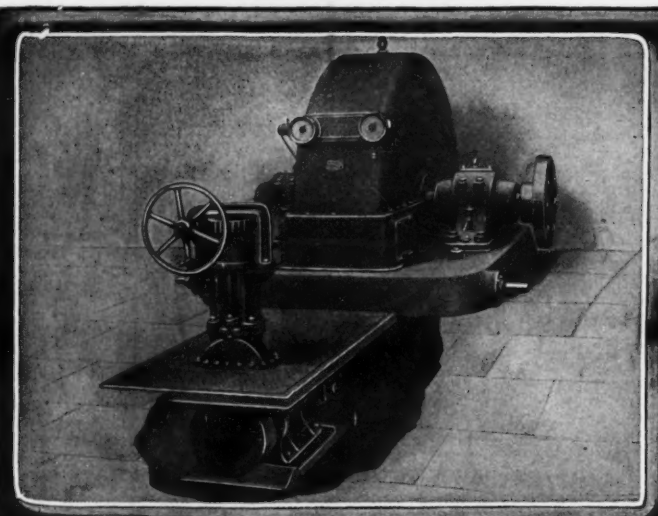

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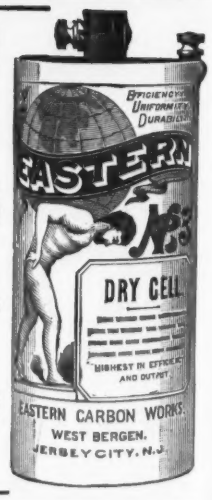

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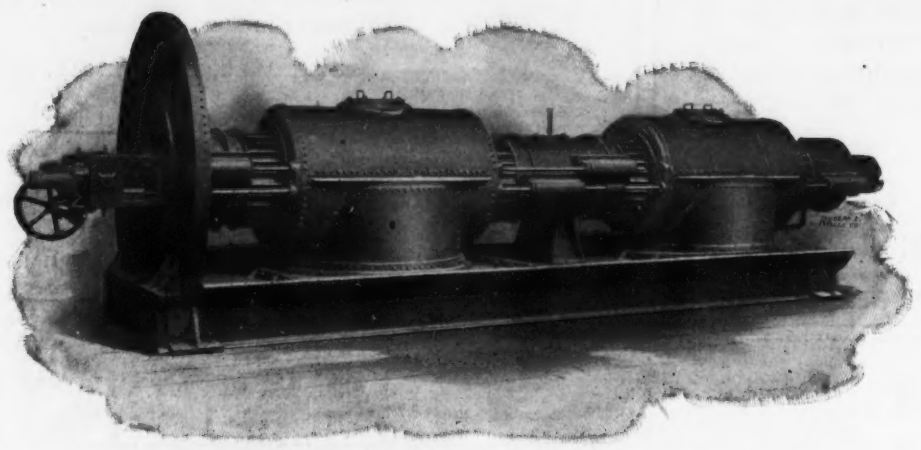

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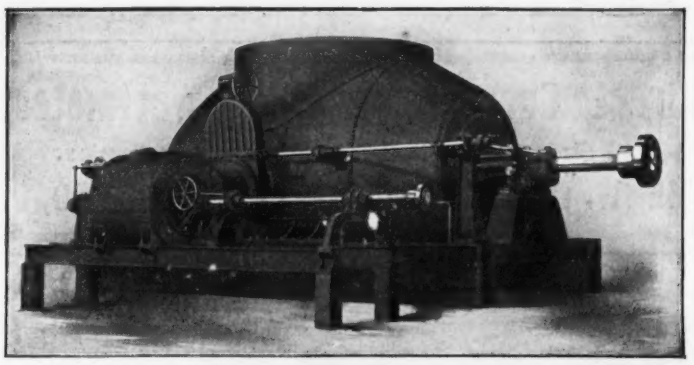

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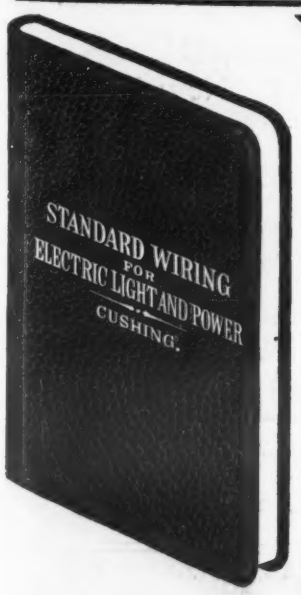

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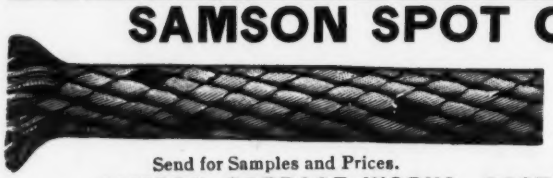

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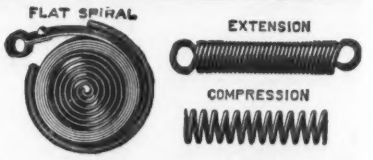

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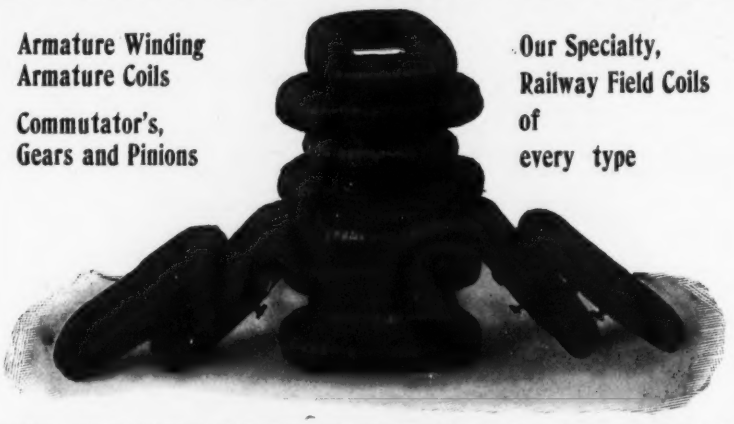

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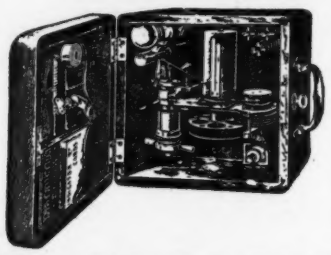

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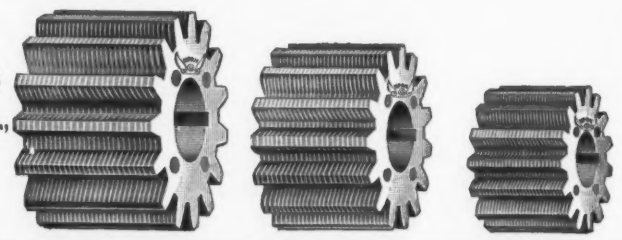

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1— 25	Triumph, M.P. Com.	1400
1— 30	Brush, Self Oiler,	1500
2— 32	Wood, Self Oilers,	1750
14— 35	Hobart, M.P. Comp.	1700
1— 40	Wood, Self Oiler,	875
4— 45	W'house, M.P., Com.	1800
1— 50	N. E. Comp., S. O.,	1650
1— 50	Wood, Self Oiler, M.P.	1250
1— 50	Crocker-Wheeler, S. O.	1150
1— 50	C. & C., Comp., S. O.	1150
1— 35	Crocker-Wheeler, S.O.	1200
5— 55	Edison, S. O., 3-K.W.	1900
19— 60	Hobart, M. P., Comp., S. O.	1200
1— 75	Hobart, M. P., Comp.	1300
1— 75	Bostedo, M. P., S. O.	1200
1— 80	Riker, M. P., Comp., S. O.	1100
1— 80	New England, M. P.	1450
1— 80	Perrett, M. P.	950
1— 100	Card, M. P.	1000
2— 100	Hobart, M. P., Comp.	1500
2— 100	Northern, M. P., Comp.	1600
1— 150	Western Electric, M. P.	1650
1— 150	Western Electric, M. P.	1300
1— 180	Bernard, Self Oiler,	1800
1— 200	Eddy, Self Oiler,	1900
1— 210	C. & C., M. P.	1100
2— 210	Edison, S. O., 12-K.W.	1500
1— 250	Comm'l Comp., S. O.	1460
1— 300	Phoenix, M. P., 15-K.W.	1100
2— 300	Jenney, Self Oilers,	1400
1— 300	Ahlms-Edwards, M. P. Comp.	825
2— 350	Edison, 20-K.W., Comp. S. O.	1400
1— 350	C. & C., Comp.	750
2— 350	C. & C., M. P., 20-K.W.	850
1— 350	Card, M. P., Enclosed	1000
1— 350	Card, M. P., S. O.	1000
1— 400	W'house, M.P., Comp.,	975
1— 400	C.-W., M.P., Comp.,	875
1— 400	Northern, 22½-K.W. M. P., Comp.	1000
1— 450	Rockford, Comp., S.O.	1250
2— 450	Comm'l, M. P., Comp.	1000
1— 450	C. & C., M. P., 25-K.W.	1700
6— 450	Edison, 25-K.W., S. O.	1300
1— 500	Jenney, Comp, 30-K.W.	1350
3— 540	Mather, Comp., S. O.	1300
1— 540	C. & C., M. P., 30-K.W.	750
1— 540	Fisher, M. P., Comp.	850
2— 540	General Elec., M. P. Comp., 30-K.W.	1000
1— 540	Edison S. O., Shunt, 30-K.W.	1200
2— 600	Card, M.P., Comp.	850
1— 600	Card, M.P., S. O.,	900

Light.		Speed.
2— 700	Commercial, M.P., Comp.	865
1— 750	Card, M. P., Comp.	750
2— 800	Edison, 45-K.W. Comp.	1000
1— 900	Jenney, Comp., S. O.	900
1— 700	Westinghouse, M. P., Engine Type for D.C, Comp., 35-K.W.	375
2—1000	Edison, S. O., 60-K.W., Comp.	700
1—1200	Gen. Elec. D. C. to Weston Eng.	275
1—1350	Waddell Entz, 80-K.W. D. C. to Ball Eng., 15x14	275
1—1400	S. & H., Comp., S. O., 70-K.W.	800
1—1400	Ft. Wayne, D.C. to 13x14 Buckeye, vertical engine, 80-K.W.	275
1—1500	Card, M. P., Comp.	500
2—1500	G. E., M.P., 6 Pole D. C. to Ames Tandem Comp. 11x17x12 Automatic Engine,	270
3—1800	Edison, 100-K.W., S. O., Comp.	650

220 VOLT GENERATORS.

K.W.		Speed.
1— 9	New England, M. P.,	1600
1— 12	Edison, Self Oiler,	1600
1— 12	New England, 8 pole	800
1— 15	Edison, Self Oilers,	1500
1— 20	Northern, M. P.	850
1— 20	Edison, Self Oiler, comp.	1400
1— 20	Wagner, M. P.,	1200
1— 20	Diehl, M. P., Comp.	925
1— 25	Crescent, M. P.	1000
1— 25	Commercial, S. O., comp.	1380
1— 37½	Keystone, M. P. comp.	800
1— 37½	Crocker-Wheeler, M. P.	950
1— 40	Card, M. P.,	850

K.W.		Speed.
1— 40	Comm'l, M. P., D. C. to 13x12 Automatic Chandler Taylor eng.	300
1— 45	Am. Engine Co., M. P.	750
2— 45	Edison, Comp., S. O.,	1000
1— 45	Gen. Elec., M. P.,	925
1— 55	Fuller, Multipolar,	750
1— 62	T. H. D 62, comp.,	900
1— 70	Western Elec., S. O.,	585
3— 75	Seimens & Halske, Churchward type, M. P., Brand New, for D. C.,	300
1— 80	C. & C., Comp. self oiler	625
1—100	Edison, Comp., S. O.,	900
1—125	Thompson Ryan, M. P.,	375
1—125	Seimens & Halske, M.P., Either for belted or D. C. to engine, can be wound for 200, 250 or 300 R.P.M.	

500 VOLT GENERATORS.

K.W.		Speed.
2— 45	Edison, Comp., New Armt., S. O.,	1000
1— 50	T. H. D 50,	1020
1— 60	Westinghouse,	525
2— 60	Edison, Comp., Self Oiler, new armt. and commutator.	700
1— 62	T. H. D 62, S. O., Comp.,	900
1— 75	Akron, M. P. 6 pole,	900
1— 75	Bullock, M. P.,	900
2— 75	Gen. Elec., M. P., 4 comp, New Rewound,	700
3—100	Edison, comp.,	650
3—100	G. E., M. P., 4 comp.,	650
1—100	W'house, M. P., 6 comp.,	650
1—120	W'house, M. P., comp.,	625
2—250	W'house, M. P., 6 comp.,	550
1—200	Gen. Elec., M. P., 4, comp., S. O.,	400

125-133 CYCLE ALTERNATING GENERATORS.

Light.		Speed.
2— 600	Westinghouse, 30-K.W., with exciter, S. O.	2000
4— 600	Gen. Elec. A 30, toothed armature, comp., with exciter,	1500
1— 650	Thomson-Houston A 35, with exciter, S. O.,	1500
4— 650	Wood, 33-K.W. comp., toothed armature, with exciter, S. O.	1680
1— 750	Wood, 37½-K.W. toothed armature, comp., with exciter	1400
1— 900	Warren Medberry, 45-K.W., ind. type, with exciter,	1300
3—1000	Wood, 50-K.W., toothed armature, comp., with exciter,	1400
1— 900	W'house, 45-K.W., comp., toothed armature, self oiler, with exciter,	2000
2—1200	Westinghouse, 60-K.W., toothed armature, with exciter, comp.,	1650
1—1200	Gen. Elec. A 60, comp. toothed armature, with exciter,	1500
1—1200	Gen. Elec. type A. S., 60-K.W. slotted, armature, composite wound, with exciter,	1500
1—1200	Westinghouse, 60-K.W., Late type, comp., toothed armature, with exciter,	1332
3—1300	T. H. A 70, comp., self oiler, with exciter,	1070

1100 VOLTS.

1—1500	Westinghouse, 75-K.W., with exciter, S. O.,	1375
3—1500	Wood, 75-K.W. comp., toothed armature, with exciter,	1050
1—1800	Standard, 90-K.W. inductor type, with exciter,	1000
1—1800	G. E. 90-K.W., type A. S 90, comp. slotted armatrue, with exciter	1250
1—1800	Westinghouse, 90-K.W. comp., toothed armature, with exciter,	1500

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1—80-K.W. Jenny, 125 volts, D. C. Russell, 4 valve.
1—50-K.W. General Electric, 125 volts, D. C. Armington & Sims.
1—50-K.W. Walker, 125 volts, D. C. Russell automatic.
1—43-K.W. Westinghouse, 125 volts, D. C. Russell automatic.
1—40-K.W. General Electric, 220 volts, D. C. McEwen automatic.
1—8-K.W. Crocker Wheeler, 125 volts, D. C. Case, vertical.
3 to 7½-K.W. D. C. sets (new).
1—6-K.W. Perrett, 125 volts, D. C. Case, vertical.

500-550 VOLT GENERATORS AND MOTORS

4—100-K.W. General Electric, M. P.
1—120-K.W. C. & C., 6 pole.
1—100-K.W. C. & C., 6 pole.
5—D. 62-K.W. Thomson-Houston, B.P.
3—60-K.W. Edison bi-polar.
1—75-H.P. C. & C., 6 pole motor.
1—50-H.P. C. & C., 4 pole motor.
1—12-H.P. Edison, bi-polar.
1—7½-H.P. American Ball, 4 pole.
1—7½-H.P. T. H., bi-polar.
1—5-H.P. C. & C., 4 pole.
1—4-H.P. C. & C., bi-polar.

220 VOLT GENERATORS AND MOTORS

1—120-K.W. C. & C., 6 pole.
1—100-K.W. C. & C., 6 pole.
1—60-K.W. Edison bi-polar.
1—25-H.P. Novelty motor.
1—15-H.P. Keystone, compound.
1—7½-H.P. American Ball, 4 pole.
1—5-H.P. Diehl, bi-polar.

110 VOLT DYNAMOS AND MOTORS

1—45-K.W. Edison, bi-polar.
1—30-K.W. Loomis, 4 pole.
1—27-K.W. Crocker Wheeler, 4 pole.
2—25-K.W. Edison bi-polar.
2—20-K.W. Edison bi-polar.
1—10-K.W. Detroit, 4 pole.
1—6½-K.W. Crocker Wheeler, 4 pole.
1—32-H.P. Crocker Wheeler, motor.
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1—14⅛x28 Delamater Corliss.
2—11½x17½x16 Buckeye, cross comp.
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1—290-H.P. Heine, 150 lbs. pressure.
1—267-H.P. Abendroth & Root, 150 lbs. pressure.
1—200-H.P. Heine, 150 lbs. pressure.
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2—66x15' return tubular, 100 lbs.
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2—100-H.P. Locomotive type.

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2—65-Light Brush, No. 8, 9.6 amp.
1—40 Light Wood, No. 7, 9.6 amp.
1—30-Light Brush, 9.6 amp.
2—20-Light T. H., 9.6 amp.

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1—60-K.W. G. E., A-10-60, 125 cycles, single phase, 1100 volts.
1—30-K.W. Westinghouse, 125 cycles, single phase, 1100 volts.
1—30-K.W. National, 125 cycles, single phase, 1040 volts.
1—10-H.P. Churchward, 125 cycles, single phase, 110 volts.
1—5-H.P. Ft. Wayne, single phase, 125 cycles, 110 volts.
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6—T. H. D-62.
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2—Gen. Electric, 100-K.W., 4 pole.
1—Westinghouse, 175-K.W.
1—Gen. Electric, 250-K.W.
4—T. H., 270-K.W., arranged to be driven with a single pulley clutch coupling on either side of pulley.
2—T. H., 500-K.W.

110 VOLT GENERATORS

2—14-pole, 210-K.W. Gen. Elec. design, for a direct connection at a speed of 120 r.p.m.

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10—No. 10, 100-light, 9.6 Ampere Brush Arc Dynamos, with oil regulators, practically new.
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1—35-K.W. Westinghouse, with exciter and switchboard instruments, 1100 volts.
1—60-K.W. Westinghouse, without exciter and switchboard instruments, 1100 volts.
2—100-K.W. G. E. mono-cyclic, with exciter and switchboard instruments complete, 1100 volts.
2—180-K.W. Stanley, 1100 or 2200 volts, with exciter and switchboard instruments.

MOTORS

180—New 25-H.P. Motors, complete with pinion, gear and gear cases.

CONTROLLERS

100—"K" Controllers.
25—K-2 Controllers.

ENGINES

1—Tandem Compound Ball, 8 and 13 x 12.
2—Tandem Compound Balls, 9 and 16 x 12.
2—Russel Automatic, 15 x 20.
2—Porter-Allen, 16 x 20.
2—11 and 17 x 14, Cross-Compound Ideal.
2—21 x 18 Armington & Sims.
1—Hamilton-Corliss, 14 x 42.
1—St. Louis Corliss, 30 x 54.
1—Penn. Iron Works Corliss, 28 x 60.
2—Lane & Bodley, 24 x 60, designed for Rolling Mill work.
1—20 x 48 Wheelock.
1—Double Wheelock, 20 x 48.
1—Wheelock, 20 x 42.
1—Armington & Sims, 13 x 12.
1—Taylor-Beck, 12 x 14.
1—Houston, Stanwood & Gamble, Cross-Compound, 16 and 22 x 22.
1—Cooper Cross-Compound, Non-Condensing, 36 and 60 x 60, new, never having been shipped from the factory.
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3—Skinner engines, 17 x 18, with air compressing cylinders attached.

BOILERS

4—66 in. x 18 ft., with 66 4-in. tubes.
3—66 in. x 14 ft., with 66 4-in. tubes.
2—72 in. x 18 ft., with 79 4-in. tubes.
2—Sterling water-tube, each 350-H.P.
2—Hazleton, 500-H.P.

A complete Edison three wire plant of 300-K.W. capacity at a great bargain.

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Large stock of Meters, Arc Lamps, Station Instruments and Supplies. All apparatus fully guaranteed in perfect operative condition. Send for Monthly Bargain Sheet with complete list and net prices.

Light.		Speed.
3—2400	Westinghouse, 120-K.W. comp., S.O., toothed armt., with exciter,	1375
2—2400	Gen. Elec. 120-K.W., type A 120, toothed armature, composite, with exciter,	1070
2—2400	Gen. Elec. 120-K.W., type A 120, late type comp., toothed armature, with exciter,	1070
2—2400	Gen. Elec. 120-K.W. type A. S. comp., slotted armature, with exciter,	1070
2—3000	Stanley, 150-K.W., Inductor type, 2 phase, with exciter,	800
1—3000	Gen. Elec, 150-K.W., monocyclic, toothed armature, comp., with exciter,	825
2—4000	Stanley, inductor type, 200-K.W. 1100 or 2200 volts, 2 phase, with exciter,	670
1—1800	W'house, 400-K.W., slotted armature, 3 bearings, distributed windings, with exciter, extra fine,	445

ALTERNATING GENERATORS. 60 CYCLES. 1100 VOLTS.

Light.		Speed.
1— 300	Gen. Elec. 15-K.W., comp., toothed armature, with exciter,	720
1— 500	Westinghouse, 25-K.W. comp., toothed armature, with exciter,	900
1—1500	Warren-Medbury, 75-K.W., 2 phase, inductor type, with exciter,	600
2—1500	Westinghouse, 75-K.W. toothed armature, comp., with exciter,	600
1—1500	Stanley, inductor, 75-K.W., 2 phase, 1100 or 2200 volts, with exciter,	900
1—1500	Wood, 75-K.W., comp. slotted armature, with exciter,	600

Light.		Speed.
1—1200	Westinghouse, 60-K.W., toothed armature, comp., with exciter,	720
1—1200	Gen. Elec. A. S. 60, 60-K.W., toothed armature, comp., 8 poles, with exciter,	900
1—3000	W'house, 150-K.W. comp., toothed armature, 12 poles, with exciter,	600

ARC DYNAMOS.

Light.	C.P.		Speed.
1— 30	1200	T. H. K 12 Ball,	
1— 35	2000	T. H. LD2, Ball,	820
1— 45	1200	Brush, No. 7, with latest improved Stubenrausch commutator,	1050
1— 45	1200	T. H. M 12 Ball,	850
1— 50	1200	T. H. L D 12, new Ball,	820
2— 50	2000	T. H. M. D. 2, S. O., ring,	820
1— 65	2000	Brush, No. 8, with latest improved Stubenrausch commutator,	950
3— 75	1200	T. H. M D 12, S. O., ring,	820
1— 75	1200	Wood,	950
1—125	1200	Brush, 6.6 amp. No. 9,	700
2—125	2000	Brush, 9.6 amp. No. 11,	500
1—125	1200	Excelsior,	700

110 VOLT MOTORS.

H.P.		Speed.
6—	¼ Towle, self oiler,	1500
1—	½ Roth, self oiler,	1950
2—	½ Towle, self oilers,	1600
1—	½ New England, M. P.	1900
1— 1	New England,	1000
1— 2	Wagner, M.P., S.O.,	1800
1— 2	E. & C., M. P.,	2350
1— 1	Jenney, self oiler,	2200
1— 1¼	Keystone, self oiler,	2100
1— 2	Triumph, M. P., S. O.,	1200
1— 2	New England,	1150
1— 2	Perrett, self oiler,	1900
5— 2½	New England, type B,	1800
2— 2½	Crocker-Wheeler, S. O.,	1150
1— 2	T. H. D 1½, self oiler,	2100
1— 2½	Wood, self oiler,	750
14— 2½	Hobart, M. P., self oilers	1450
1— 3	New England,	1000
1— 3	Crocker-Wheeler, S. O.,	950
1— 3	Wood, M. P., self oiler,	1000
1— 3	Elbridge, self oiler,	1800
1— 3	New England,	1450
4— 3	Westinghouse, M. P.,	1700
2— 4	Bernard, self oilers,	1500
19— 4	Hobart, multipolar,	1000
5— 4	Edison, S. O., 3-K.W.,	1700
1— 4	C. & C., M. P.,	1550
1— 5	Hobart, M. P.,	1050
1— 5	Perrett, M. P.,	750
1— 5	Nowotny, self oiler,	1250
1— 5	Westinghouse, M. P.,	1500
1— 5	Bostedo, M. P.,	900
1— 5	N. E., M. P., new,	1100
1— 5	S. & H. series gear connection,	700
1— 5	Gregory series gear connection,	1460

H.P.		Speed.
1— 5	Aaron, self oiler,	1800
1— 6	Riker, M. P.,	750
1— 7½	Card, M. P.,	725
2— 7½	Northern, multipolar,	1400
8— 7½	Commercial, multipolar,	1100
2— 7½	Hobart, M. P.,	1250
9— 7½	New England, M. P.,	1100
1— 9	Bernard, self oiler,	1450
1— 10	Western Electric, M.P.,	1400
1— 10	Western Electric, M. P.,	1250
1— 12	Bernard, self oiler,	1400
1— 15	C. & C., M. P.,	800
1— 15	Eddy, self oiler,	1500
2— 15	Edison, S. O., 12-K.W.	1275
1— 17	Bernard, self oiler,	1500
1— 18	Bain, self oiler,	950
1— 18	Commercial, self oiler,	1200
1— 18	Rockford, self oiler,	1150
2— 20	Jenney, self oilers,	1200
1— 20	Phoenix, M. P.,	950
1— 22	Ahlms-Edwards, M. P.,	750
1— 25	C. & C., self oiler,	650
4— 25	Edison, self oilers,	1100
1— 25	Card, M. P.,	800
2— 25	C. & C., M. P.,	625
6— 30	Edisons,	950
1— 30	C. & C., M. P.,	550
2— 30	Commercial, M. P.,	725
2— 30	Rockford, self oiler,	1000
1— 30	Westinghouse, M. P.,	750
1— 30	Crocker-Wheeler, M. P.,	800
1— 30	Northern, M. P.,	850
2— 30	Gen. Elec., M. P.,	900
1— 35	Edison, self oiler,	950
1— 35	Akron, M. P., self oiler,	
2— 35	Gen. Elec., M. P.,	800
1— 35	Jenney, self oiler,	1050
1— 35	C. & C., M. P.,	500
2— 35	Card, M. P.,	650
1— 35	Fisher, M. P.,	600
1— 45	Card, M. P.,	550
1— 50	Rockford, self oiler,	1050
2— 50	Commercial, M. P.,	650
1— 60	Jenney, self oiler,	730
4— 60	Edison, 45-K.W., S. O.,	750
2— 75	Edison, self oilers,	650
1— 85	S. & H., S. O.,	650
1—100	Card, M. P.,	400
3—125	Edison, S. O.,	500
6—	¼ Towle, self oiler,	1500
1—	¼ Lundell, for liontype machines, complete with gear,	645
1—	½ Paragon, self oiler,	1700
1— 1	Roth, self oiler,	2100
5— 1	Towle, self oiler, M. P.,	1300
1— 1	Paragon, self oiler,	1100
1— 2	Edison, self oiler,	1600

STATION EQUIPMENT COMPANY, 204 DEARBORN ST., CHICAGO.

200-K.W. Stanley, 2 phase 60 cy. alternator, 2750 or 5500 v.
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120-K.W. G. E., 133 cy. A. or A. S. type, 1100 or 2200 v.
150-K.W. Ft. Wayne, 133 cy. 220 v.
175-K.W. Edison bi-polar 250 v. generator.
200-H.P. Edison, 250 v. shunt motor.
45-K.W. and 30-K.W. Edison 110 v. generators.
50-Lt. 2-C.P. T-H arc dynamo.
14 and 26x42 Allis cross compound condensing Corliss engine, with 18' band wheel.
16 and 30x48 Cooper cross compound condensing Corliss engine, 500-H.P., good for 150 lbs. steam, 20' sectional band wheel, independent condenser.
Simple automatic engines from 350-H.P. down.
Write for stock list No. 37.

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40 K. W. 110 VOLT EDDY DYNAMO TO BUFFALO FORGE ENGINE.

110 Volt Dynamos or Motors

275— Eddy, M. P.
150-Lt. C. & C. 100-Lt. Bullock.
25-Lt. Excelsior.
50, 40, 15-Lt. Sprague Lundell.

All sizes 220 Direct Current Motors, 1-4 to 20 H. P.

500 Volts Direct Current

7½-5-1-H.P. General Electric.
5—2½-H.P. Westinghouse.

ALTERNATING MOTORS

2 Phase 60 Cycle 220 Volts

30-H.P., 15-H.P., 10-H.P., 7½-H.P., 5-H.P., 2-H.P. Westinghouse.
15-H.P., ½-H.P., ¼-H.P. General Electric.
10-H.P., 1-H.P. Stanley.

3 Phase 60 Cycle 220 Volts

30-H.P., ½-H.P. Gen. Elec.
½-H.P., 110 volts, 60 cycle.

1 Phase 60 Cycle 110 Volts

5-H.P., 1-H.P., ½-H.P. Wagoners.
½-H.P., ¼-H.P. Gen. Elec.

2 Phase 125 Cycles

7-H.P. Stanley 500 volts.
1-H.P. Stanley, 500 volts.

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23x60 450-H.P. George H. Corliss.
20x48 300-H.P. Harris Corliss.
12 and 22x42 250-H.P. Atlas Tandem Compound Corliss.
16x42 175-H.P. Allis Corliss.
12x36 100-H.P. St. Louis Heavy Duty Corliss.
12x36 100-H.P. Hamilton Corliss.
24x48 500-H.P. Buckeye Automatic.
16½ and 28½x27 400-H.P. Buckeye Cross Compound Automatic.
15 and 23x17 250-H.P. McIntosh Seymour and Company Tandem Compound Automatic.
14x14 125-H.P. Weston High Speed Automatic.
12x12 90-H.P. Phoenix Center Crank Automatic.
10x16 60-H.P. Atlas Automatic.

BOILERS.

2—325-H.P. Heine Water Tube Boilers, 140 lbs.
2—280-H.P. B. & W. Water Tube Boilers, 150 lbs.
2—275-H.P. B. & W. Water Tube boilers, 150 lbs.
3—275-H.P. B. & W. Water Tube Boilers, 130 lbs.
1—175-H.P. B. & W. Water Tube Boilers, 125 lbs.
2—150-H.P. B. & W. Water Tube Boilers, 135 lbs.
1—72x18 Tubular Boiler, 125 lbs.
3—72x16 Tubular Boilers, 100 lbs.
3—66x16 Tubular Boilers, 100 lbs.
1—60x18 Tubular Boiler, 100 lbs.
8—60x16 Tubular Boilers, 100 lbs.
1—56x16 Tubular Boiler, 100 lbs.
2—54x14 Tubular Boilers, 100 lbs.

HEATERS.

1000-H.P. National Feed Water Heater.
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FOR IMMEDIATE DELIVERY.

600-H.P. 21 and 36x30 Williams tandem compound engine.
250-H.P. 12 and 24x18 Williams tandem compound engine.
250-H.P. 13 and 20½x15 Armington & Sims cross compound.
300-H.P. 20x18 Erie ball automatic.
75-H.P. 10x13 Frost automatic.

DYNAMOS.

180-K.W. and 120-K.W. G. E. 60 cy. A. S. type 1100 or 2200 v. alternators.
120-K.W. and 60-K.W. G. E., 133 cy. 1100 and 2200 v. alternators.
150-K.W. Wood and 50-K.W. Siemens-Halske, 60-K.W. Siemens-Halske, 2000 v. alternators.
200-H.P. Edison 200 v. motor.
Direct current 110 v. generators, all sizes.
Write for complete stock list No. 60.

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Old material of all kinds purchased.

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Must dispose of the following second-hand machinery at once:
One 16x16 Ball Engine.
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Two 400 ampere, 115 volt, United States Dynamos.
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We wish to call your attention especially to a number of dynamos we can offer for sale at very low prices.

2—20-K.W. Edison, 110 volt each	$200.00
1 Extra armature for same	50.00
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1—20-H.P. National motor in good order, 110 volt, 1200 alternations	190.00
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2—60-K.W. Edison, 220 volt each	495.00
1—90-K.W T. H. dynamo. New commutator and newly rewound throughout. Carbon brushes. 220 volts, 750 alternations	750.00
1—15-H.P. Niagara motor. Good order. 220 volts, 800 alternations	200.00
Each of these 60-K.W. machines weighs 9,780 lbs.	
1—75-K.W. G. E. 250 volts, new fields and armature, latest type, compound wound	850.00
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All the above machines are compound wound, complete with sliding bases and rheostats and guaranteed to be as represented.

ALTERNATORS.

1—2,000-Lt. Royal, nearly new, 16,000 alternations per minute, 1,100 volts, complete with armature and volt meter	$650.00
1—1,500-Lt. Royal alternator, 7,200 alternations per minute newly rewound armature, complete with ammeter and volt meter	700.00
2—National 1,000-Lt., 1,100 volts, newly rewound, 16,000 alternations per minute	300.00
2—National 750-Lt., 1,100 volts each, newly rewound, 7,200 alternations, each	175.00
1—50-Lt. 10 amp. Western Electric Co. arc dynamo, 1200 alternations	300.00
1—35-Lt. Schuyler 10 amp. arc dynamo, 1200 alternations	200.00

Each of the above alternators is complete with exciter, sliding base and rheostat and are guaranteed to be as represented.

1—10-H.P. 500 volt Eddy motor, newly rewound armature	175.00
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All the machinery in the above list was replaced by larger machinery and all is just as good as new. These prices are net F. O. B. Cleveland.

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One 12x14 McEwen center crank engine with sub-base. 120-H.P. at 110 lbs. and ¼ cutoff and 275 R.P.M. Wheels 56x12½. Engine is brand new, has never been erected and has usual complement of fittings. Cheap for cash. Address Fred W. C. Bailey, 501 Spahr Bldg., Columbus, Ohio.

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50 to 100 light T. H., Ft. Wayne or Brush arc dynamos, 9.6 amperes.
250 h. p. Corliss or medium speed automatic engine.

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FOR SALE

One 1000-K.W. direct connected vertical cross compound, side crank McIntosh & Seymour engine now completed. Revolutions per minute 120. Steam pressure 125 lbs. Rated load and indicated horse-power 1520. Cut off 26/100. This engine was ordered previous to our purchase of the Citizens Light & Power Company. We now wish to dispose of same at a bargain. The engine can be seen at McIntosh & Seymour factory, Auburn, N. Y. Address

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DIRECT-CONNECTED

1—425-kw General Electric, Type M. P., 10-425-100 R.P.M. with Compound Russell Engines.

2—300-kw General Electric, Type M. P., 6-300-100 R.P.M. with Compound Allis Engines.

DIRECT-CONNECTED UNITS

110-125 VOLTS

1—25-kw 6-pole General Electric, direct-connected to Vertical Compound Westinghouse Automatic Engine. Speed 350 R.P.M.

2—150-kw M. P. General Electric, with tandem-compound Corliss engines.

DIRECT CONNECTED ALTERNATING UNITS

2—325-kw, 2-phase Stanley, 60-cycle, 2,400 volts, with tandem Russell engines.

ROTARY CONVERTERS

2—250-kw Westinghouse, 2-phase, 7200 alternations and 535 volts direct current, speed 720 R.P.M.

4—150-kw oil-cooled transformers, 3-phase, 2-phase, 60-cycle, 9500 volts primary, 380 volts secondary.

All complete with one 4-panel switchboard.

TRANSFORMERS

3—200-kw type A. B. General Electric step-up transformers, adaptable for various voltages up to 20,000 volts.

3—180-kw type A. B. General Electric step-down transformers, adaptable for various voltages from 20,000 volts to 600 volts.

RAILWAY MOTORS

25—G. E. 1200.
50—38 B Westinghouse.
20—49 Westinghouse.
50—12 A Westinghouse.
25—68 Westinghouse.
20—69 Westinghouse.
10—G. E. 52.
10—G. E. 800.
50—No. 3 Westinghouse.
K, K2, K10, K11, K12, Controllers.

RAILWAY GENERATORS

Belted

2—500-kw General Electric, M. P.
2—300-kw General Electric, M. P.
4—200-kw General Electric, M. P.
1—200-kw Westinghouse, 6 pole.
2—100-kw General Electric, M. P.
1—150-kw Ft. Wayne, M. P. 6.
2—200-kw Edison.
1—60-kw Edison, Bipolar, M. P.
1—75-kw Thomson-Houston.
4—D62 Thomson-Houston.

EXTRA ARMATURES

1—200-kw 4 pole G. E., 500 volts.
1—200-kw Edison, 500 volts.
1—150-kw Edison, 110 volts.

BELTED DYNAMOS AND MOTORS

110 Volts

1—187-kw M. P. Westinghouse.
1—100-kw M. P. Eddy.
4—100-kw Edison.
2—60-kw Edison.
1—45-kw Edison.
2—25-kw Edison.
1—50-kw Siemens & Halske.
1—30-kw M. P. Crocker-Wheeler.
1—28-kw M. P. Lundell.

BELTED DYNAMOS AND MOTORS

220 Volts

2—100-kw M. P. Fort Wayne.
1—45-kw Edison.
1—20-kw Thomson-Houston.
1—35-H. P. M. P., C. & C.
1—25-H. P Eddy.
1—20-H. P., M. P., Sprague.
1—15-H. P., M. P., General Electric.
1—10-H. P., C. & C.
1—10-H. P., Central Electric.
1—5-H. P. Lundell.
1—5-H. P. Triumph.
1—15-H. P. Lundell.

BELTED MOTORS

500 Volts

1—60-kw M. P. Eddy.
1—40-kw M. P. Eddy.
1—30-H. P., M. P., General Electric.
3—25-H. P., M. P., General Electric.
1—35-H. P., M. P., American Ball.
2—10-H. P., M. P., General Electric.
3—7½-H. P., M. P., General Electric.
5—5-H. P., M. P., General Electric.
3—2-H. P., M. P., General Electric.

ARC DYNAMOS

1—165-light, multi-circuit Brush, No. 12 6.8 amp.
1—125-light, multi-circuit Brush, 2,000 C. P. No. 12.
1—120-light, multi-circuit Brush, 1,200 C. P. No. 9.
1—80-light, multi-circuit Brush, 2,000 C. P. No. 9.
2—M. D. 12, 75-light, Thomson-Houston arc dynamos.
4—M. D. 2, 50-light, Thomson-Houston arc dynamos.
2—L. D. 12, 50-light Thomson-Houston arc dynamos.
4—M. 2, 45-light, Thomson-Houston arc dynamos.
3—No. 8, 65-light, 2,000 candle power Brush.

ALTERNATING MOTORS

1—130-H. P. Westinghouse.
2—30-H. P. General Electric.
3—5-H. P. General Electric.
2—3-H. P. General Electric.
All of the above are 2-phase, 60-cycle, 220 volts.

ALTERNATORS

Single-Phase

1—400-kw Ft. Wayne, 1,100 volts, 125 cycle.
2—300-kw General Electric, 1,100 volts, 125 cycle.
1—250-kw Westinghouse, 1,100 volts, 125 cycle.
2—150-kw Ft. Wayne, 1,040 volts, 120 cycle, 700 R. P. M.
2—A120 General Electric, single-phase 1,000 volts, 16,000 alternations.
1—120-kw Westinghouse, 2,200 volts, 16,000 alternations, toothed arm.
3—70-kw T.-H., self-oiling, 120 cycle, 1,050 volts.
2—60-kw General Electric, single-phase, 1,100 volts, 16,000 alternations.
1—60-kw Westinghouse, single-phase, 60-cycle, 1,100 volts.
2—60-kw Westinghouse, single-phase, 16,000 alternations, 1,100 volts.
1—45-kw Westinghouse, 2,200 volts, 16,000 alternations.
1—45-kw Westinghouse, 2,200 volts, 7,200 alternations.
2—A35 General Electric, single-phase, 16,000 alternations, 1,050 volts.
1—30-kw Westinghouse, 1,100 volts, 16,000 alternations.

ALTERNATORS

2 and 3-Phase

1—650-kw 2 Phase Stanley, 133 cycle, 1,200-2,400 volts.
2—250-kw General Electric, type A. T. B., 16-250-450, 3-phase, 60-cycle, 10,000 volts.
2—325-kw 2-phase Stanley direct connected to Tandem Compound Russell Engines, condensing.
1—180 Westinghouse 2-phase generator, 2,200 volts, 60 cycles belted to Westinghouse Compound Engine 16&27x16 units, brand new, never been run.
1—150-kw Monocyclic, 3-phase, 60-cycle, 2,200 volts.
1—75-kw Stanley 2,000-1,000 volts, 2-phase, 60-cycle.
1—75-kw Westinghouse, 2-phase, 60-cycle, 2,200 volts.

BOILERS

1—250-H. P., B. & W. Boiler.
3—175-H. P., B. & W. Boilers.
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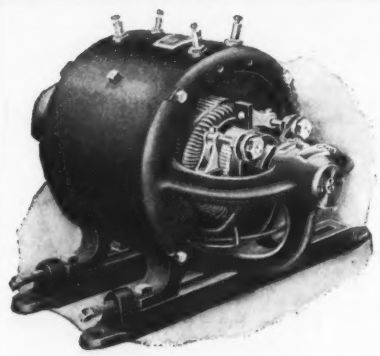

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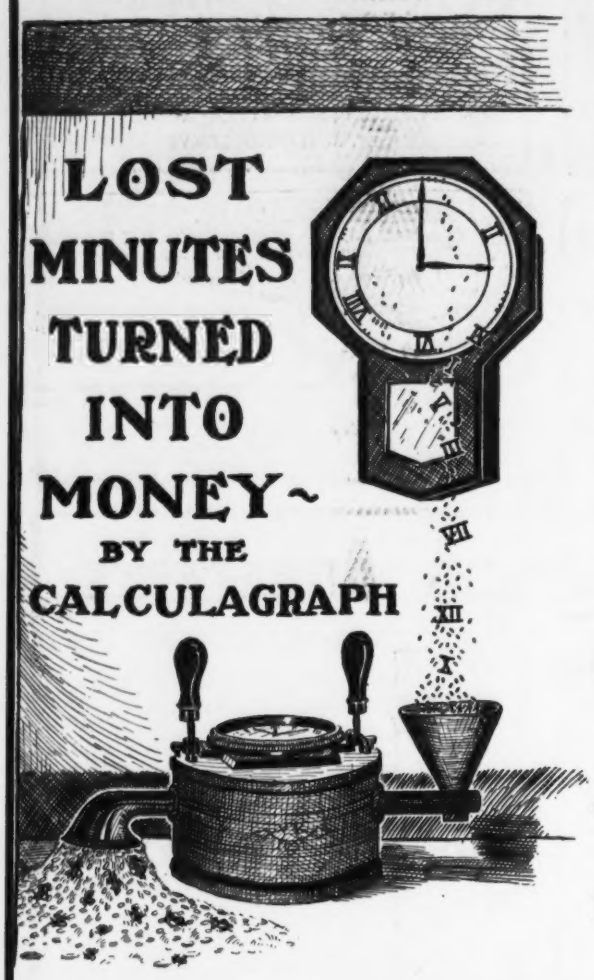

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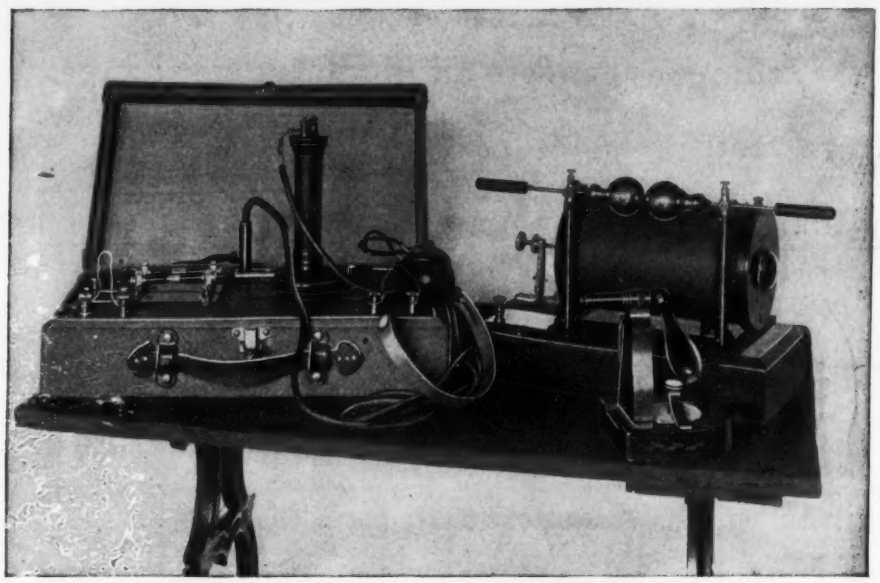

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of my well known standard types, for both Central Office and Subscribers' Stations. Over 500,000 in use. Covered by U. S. Letters Patents.

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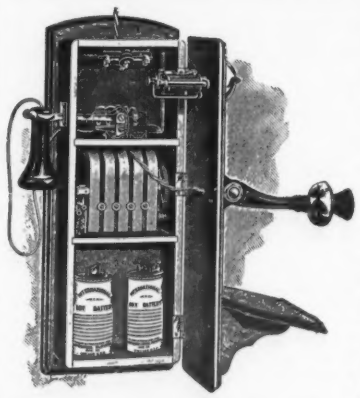

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No exposed metal parts form a part of he ci cuit at any time.
The only instrument of its kind on the market.

Transmitter clear, distinct and far-reaching, impossible todeteriorate.
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"International" apparatus embodies in the construction of the parts many new features of vital importance to the durability and efficiency of a plant.
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OWING to the various rumors recently circulated by competitors relative to the control of this company and its ability and willingness to carry out future contracts for independent telephone apparatus, we feel that the independent telephone interests, which are our present and prospective customers, are entitled to some statement from us.

To assure customers of our entire good faith and intention to continue in business as heretofore, our contracts will provide for furnishing extensions for any period desired and in addition we will furnish bonds to customers insuring the fulfillment of our contracts for new apparatus or for the furnishing of extensions of existing exchanges. Our customers will be as fully protected as ever.

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Kellogg Telephones must all undergo the severest tests—

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Each and every part absolutely uniform.

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Those who have tested ours and "the other kind," will not be surprised at this statement. Just investigate.

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80% OF THE INDEPENDENT TOLL STATIONS ARE EQUIPPED WITH S-C APPARATUS

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Friday, June 19, 1903, Judge Shiras of the United States Circuit Court for the Northern District of Iowa, sitting at Dubuque, dismissed all suits filed in the Meissner and Overshiner patent suits, against the County Telephone and Telegraph Company of Waterloo, Iowa. These suits were filed by the American Electric Company and J. B. Overshiner of Chicago, and were defended by the Eureka Electric Company of Chicago, in making good their guarantees to users of Eureka apparatus.

The Eureka Electric Company wishes to reassure its patrons that it stands back of all of its guarantees and will defend any and all suits that may be filed against its patrons for the use of its apparatus on any claims of alleged infringement.

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ELECTRICAL WORLD AND ENGINEER,
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DEAR SIR:—

It may be of interest to you to know that our advertising in ELECTRICAL WORLD AND ENGINEER has brought us a very large number of promising inquiries from lighting and street railway companies, large manufacturing plants, some of the principal steam railroads, telegraph companies, and engineers in charge of electrical installations in office buildings, hotels, apartment houses, banks, etc.

These inquiries have come, not only from all parts of this country, but from such distant places as Bombay, Greece and Mexico.

In a number of cases very satisfactory business has already resulted and in practically every instance the parties who write us are of such high standing and importance that we prize very highly the opportunity of opening negotiations with them.

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SMITH STORAGE BATTERY CO.,
A. C. ROHE, Mgr.

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Are you acquainted with the many merits of the Automatic System?
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Then you are a straggler in the march of progress.
Close up.

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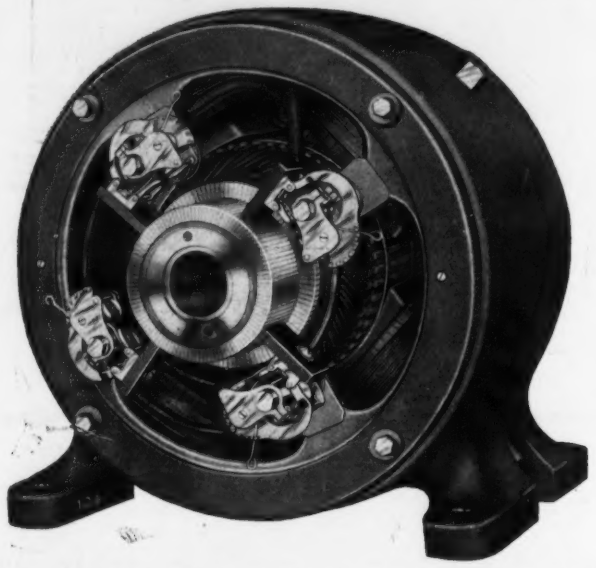
AKRON

Marine Engine Type Generators.



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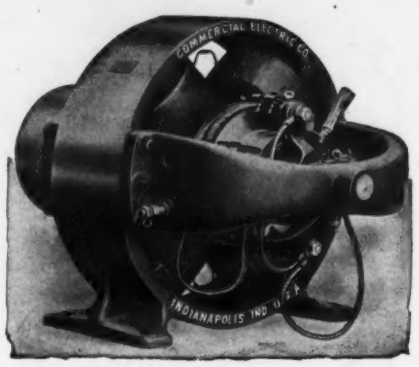

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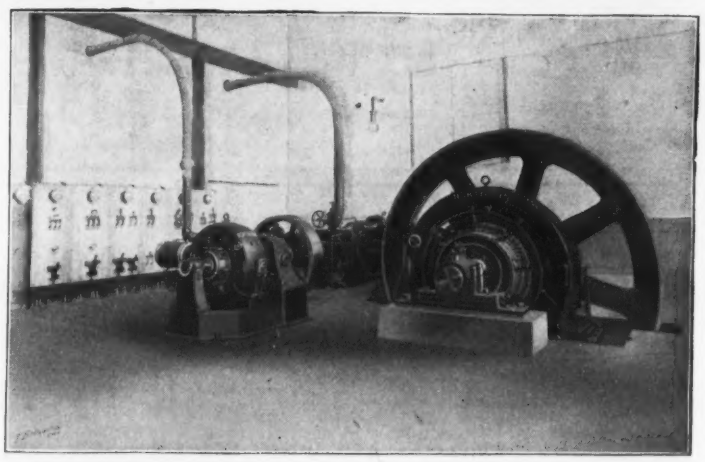
IT DOVETAILS into existing power transmission systems without disruption of methods; works gently, quietly, systematically, for the betterment of machines, tools, methods, output.

The installation of a single Northern Motor is a step which naturally progresses to the electrical equipment of the entire plant; yet, as motors are added, they do not hinder general operations; add much day by day.

Bulletin of Motors, No. 297, sent on Request

The illustration depicts a generating station equipped with Northern Generators. Our Generator Bulletin No. 307 tells about the Generators.

Northern Electrical Mfg. Co., Madison, Wis., U.S.A.



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Built in Capacities up to

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Don't decide to install any electrical machinery up to 1,000 k. w. direct, or 1,500 k. w. alternating, current until you have investigated our apparatus.

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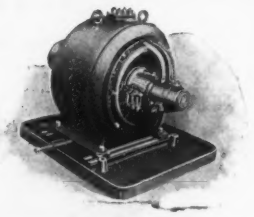

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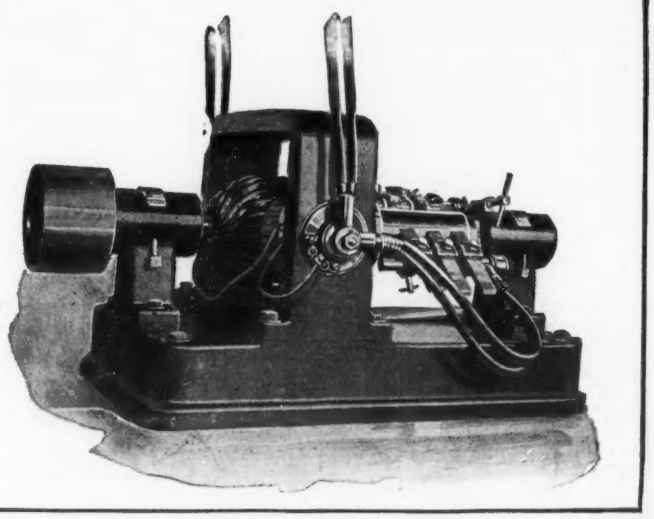

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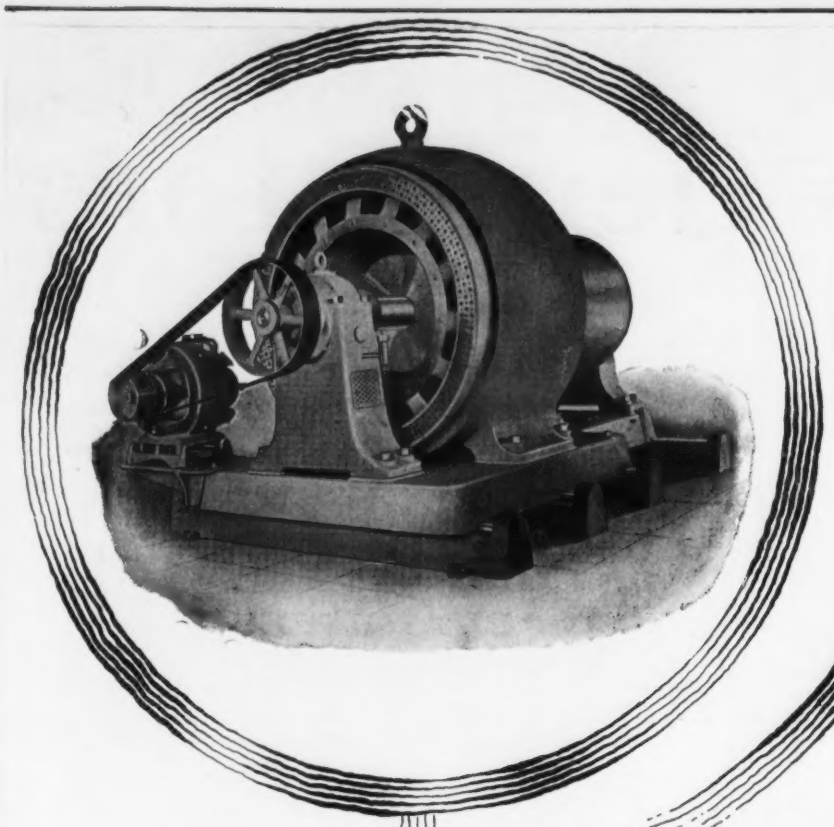

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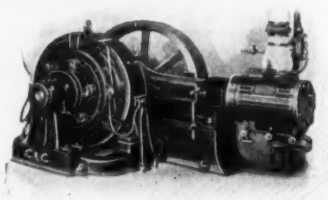

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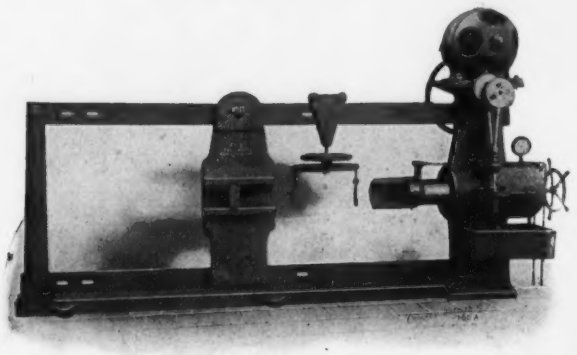

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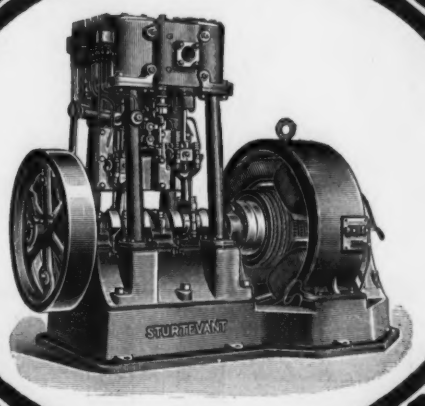

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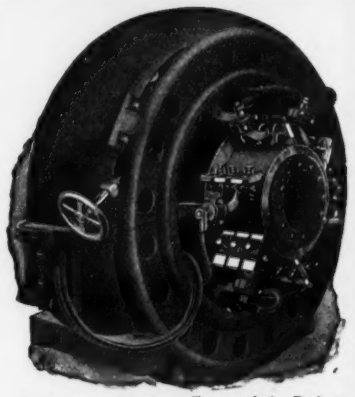

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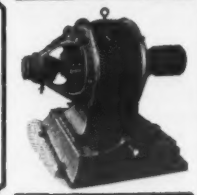

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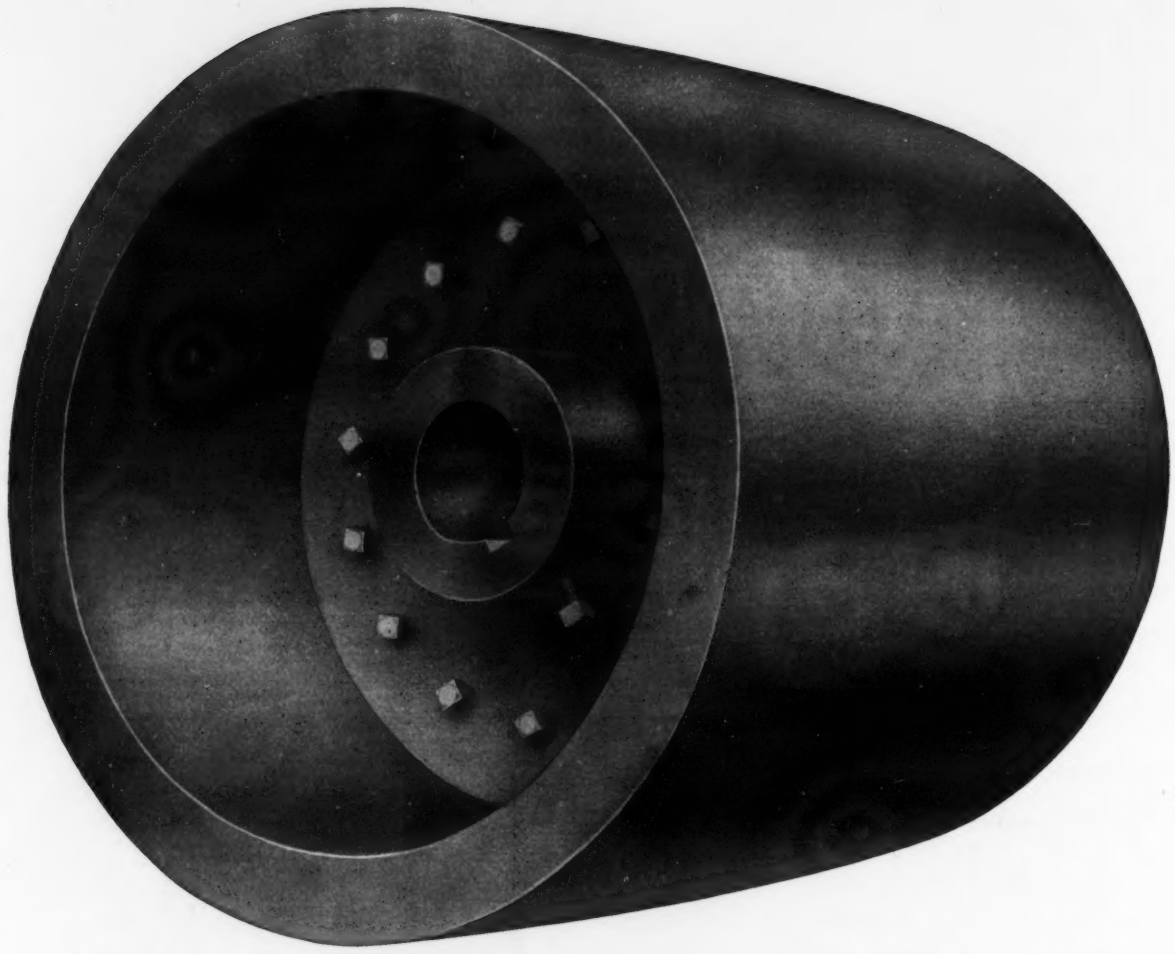

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WE MAKE ALL SIZES. NONE TOO LARGE OR NONE TOO SMALL.

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Otis Electric Sidewalk Hoist

Low in first cost.
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Engine occupies practically same space as hand-winding mechanism.
Engine can readily be connected to hoist at present hand-operated.
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Automatic device keeps starting current low and cuts out resistance as motor accelerates.

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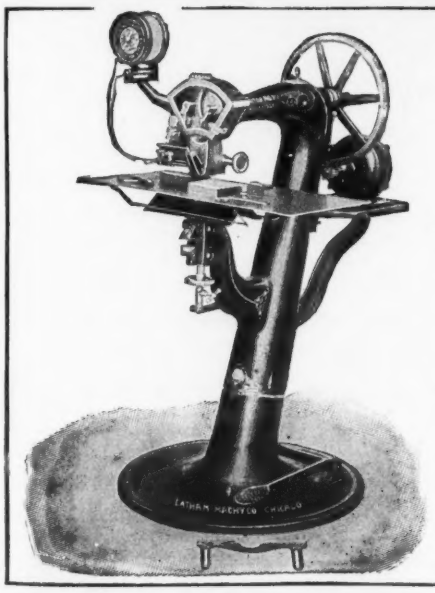

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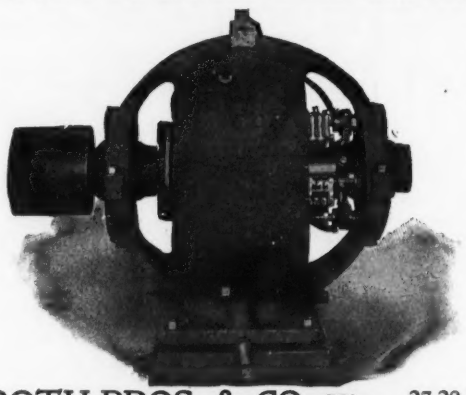

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Forms angular trough without forcing or injury;
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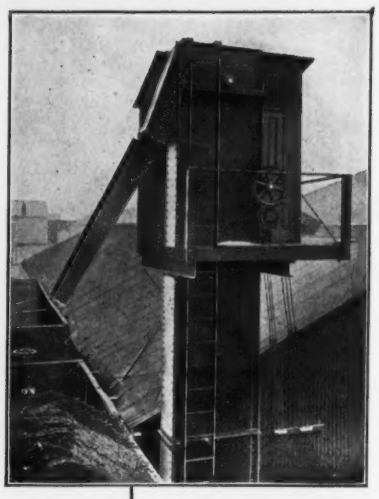

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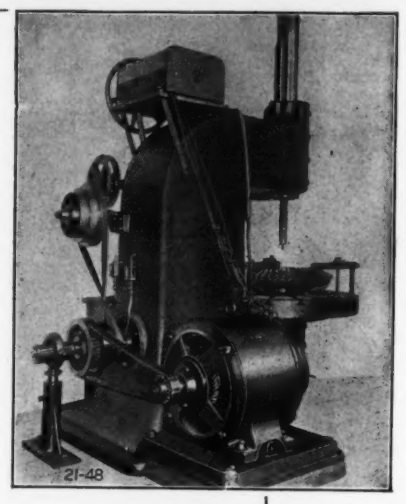

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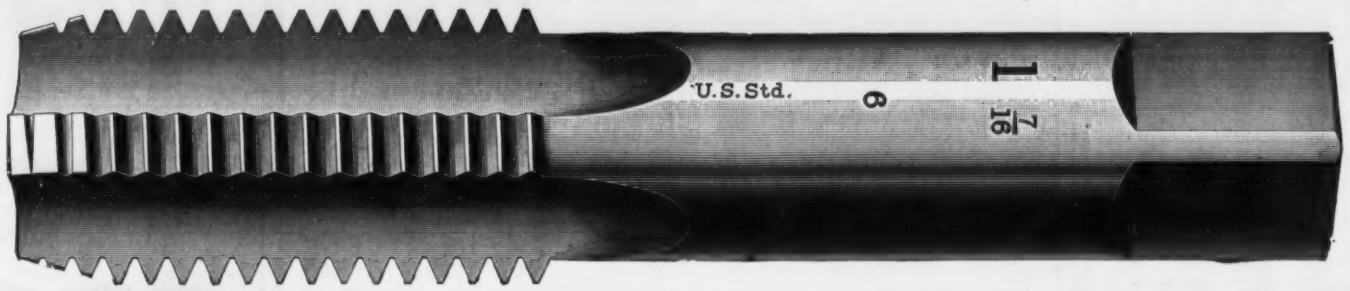

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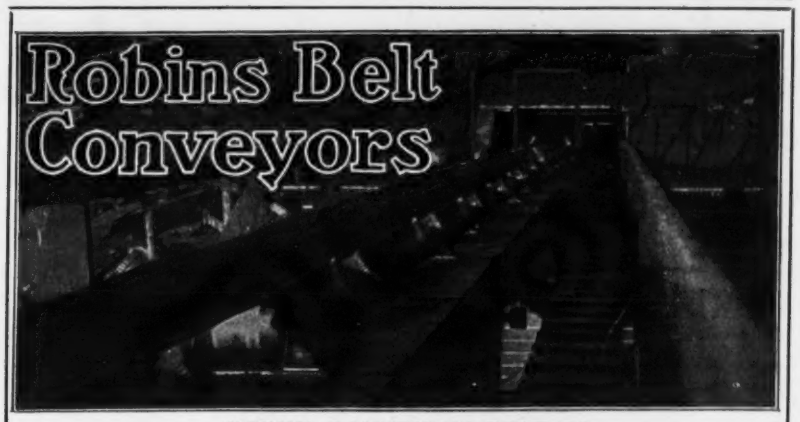

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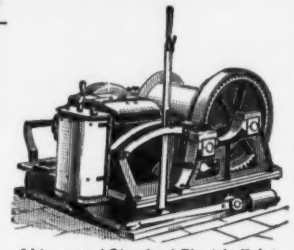
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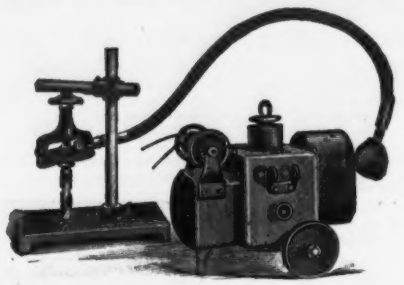

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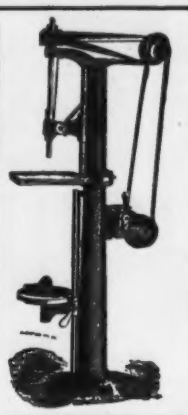

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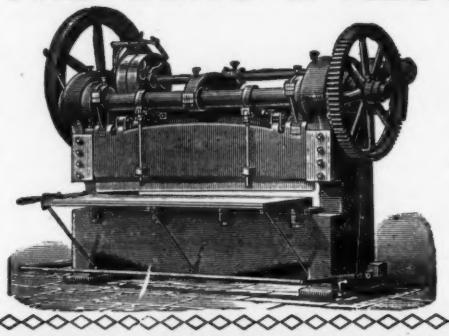

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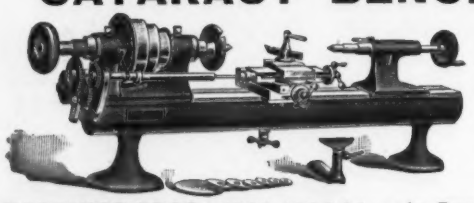

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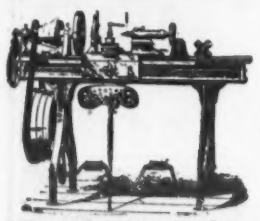

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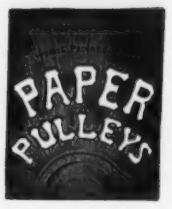

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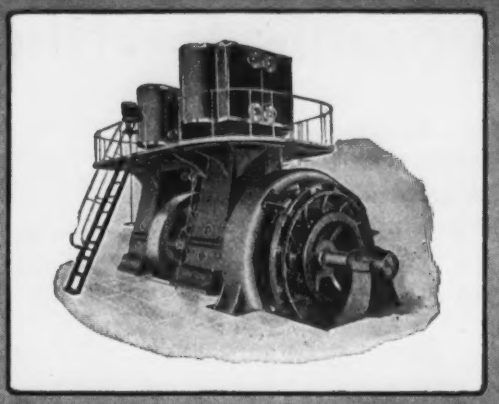

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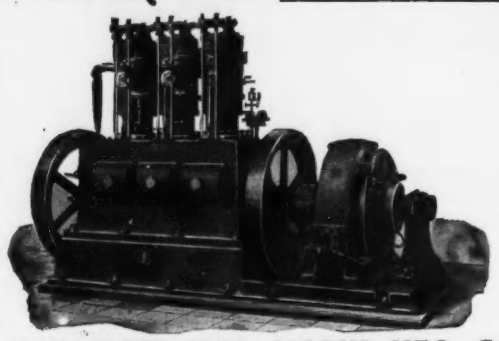

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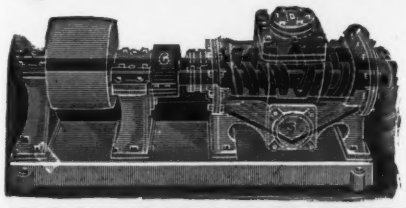

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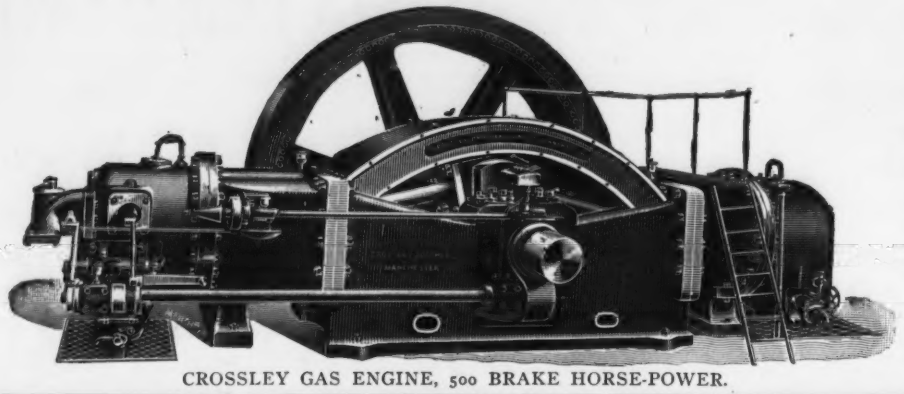

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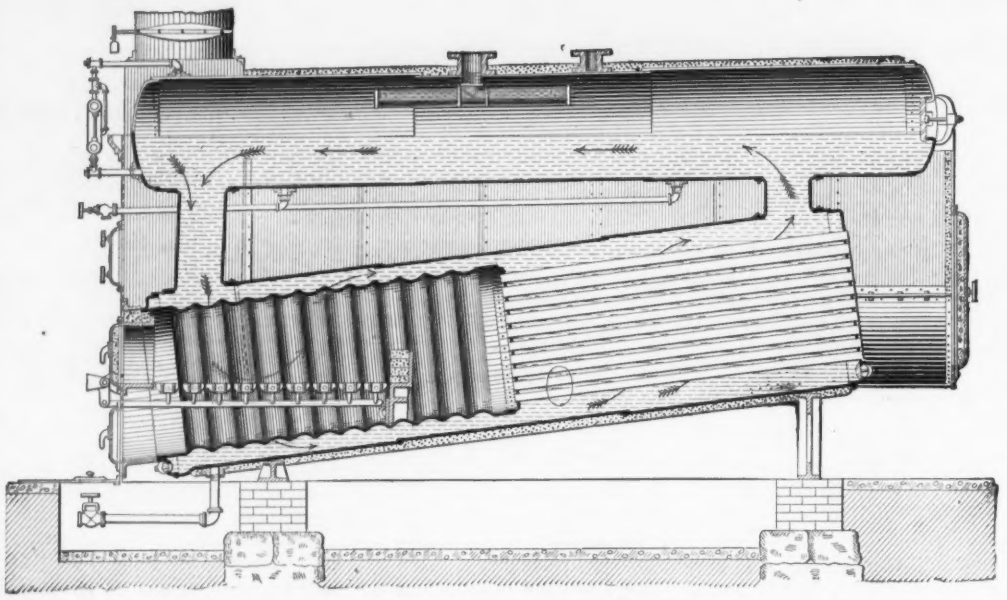

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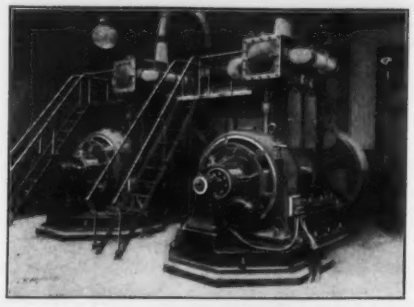

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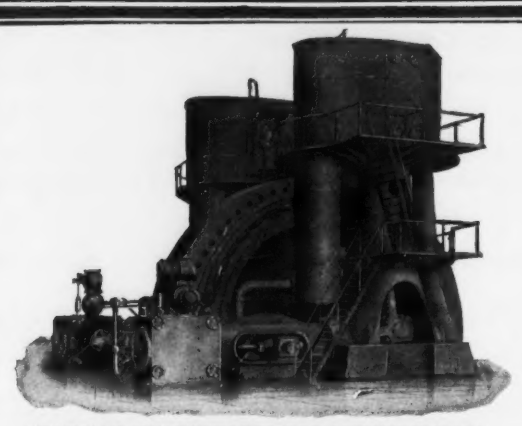

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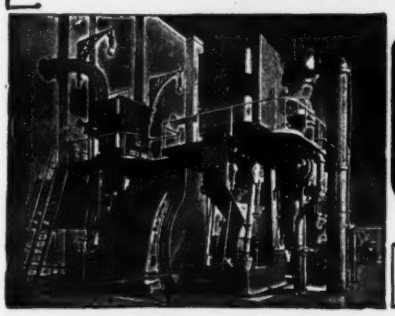

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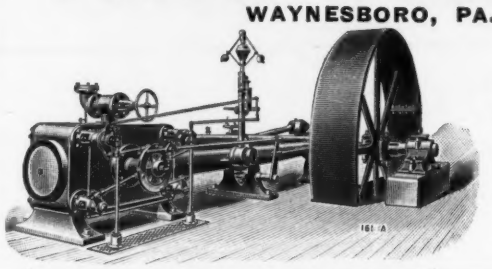

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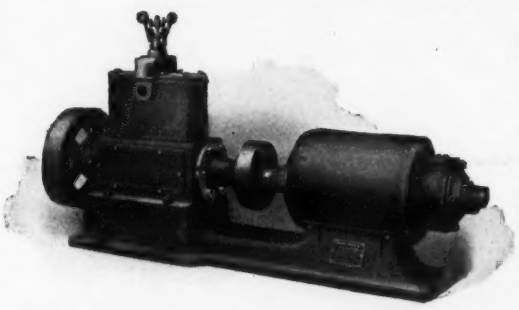

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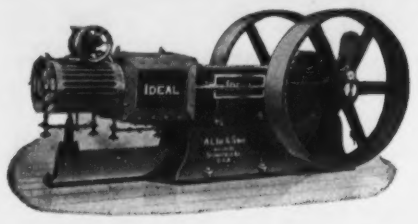

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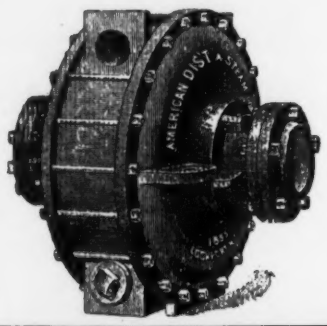

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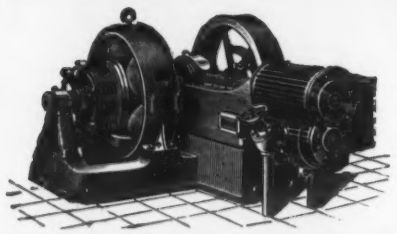

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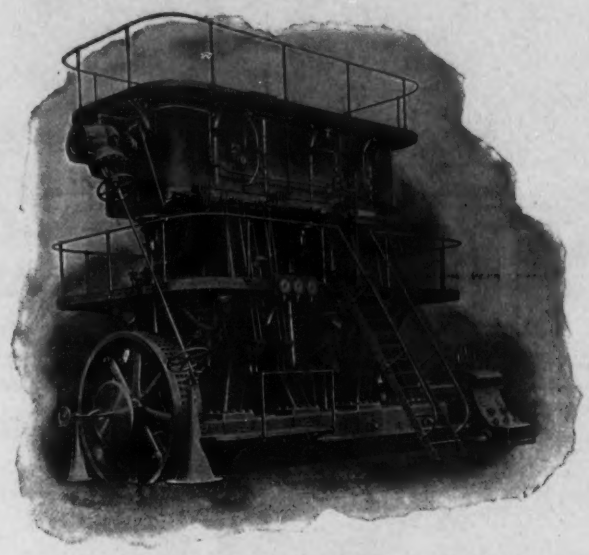

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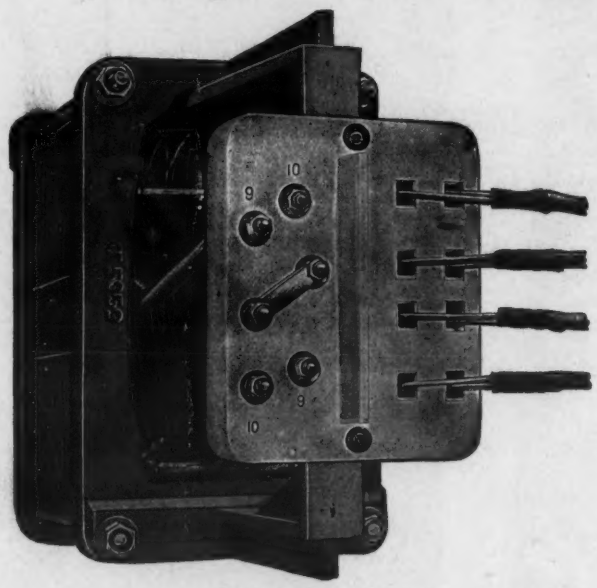

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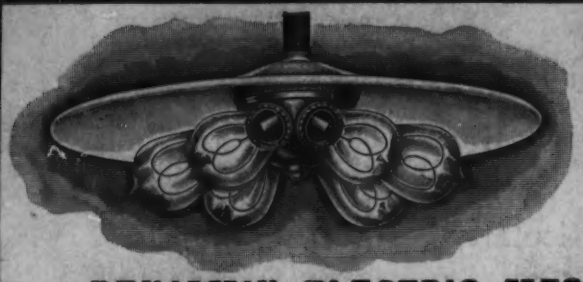
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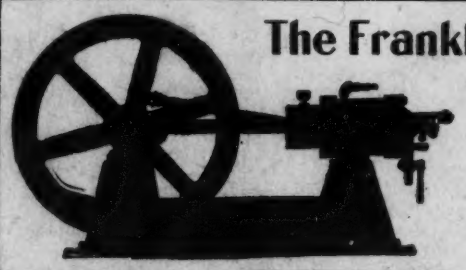
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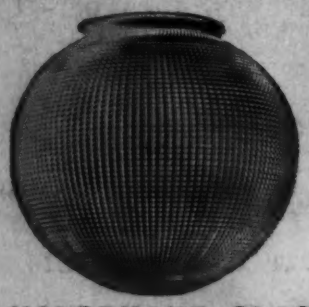
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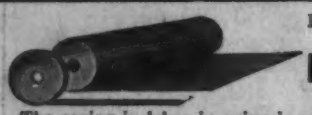
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